THE AMERICAN JOURNAL OF SCIENCE, AND ARTS.

CONDUCTED BY

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PREFACE.

As two volumes of this work are now completed, the public are in a situation to judge how far the execution has corresponded with the original plan. Not a *local*, but a *national* undertaking, its leading object is to advance the interests of this rising empire, by exciting and concentrating original American effort, both in the sciences, and in the arts, and it may with truth be said, that no Journal was ever more fully sustained by *original* communications. They have been forwarded from our cities, towns and villages, from our academies and colleges, from the East and the West, the North and the South, and even occasionally from other countries, so that the Editor feels himself justified in believing, that this work is regarded as a *national Journal*. If therefore this view be one which patriotic and honourable men can approve, and if the execution has in any good degree corresponded with the design, it is to be hoped that the American public will not permit the work to languish, for want of pecuniary patronage. This is the only material difficulty which it has encountered, and this is far from being removed. A more extended patronage is indispensable to its permanent establishment, and, should it fail on this ground, who can wonder if our national character should be even more severely (perhaps even more *deservedly*) reproached than ever.

The Editor, although called upon to sustain the *pecuniary*, as well as the more *appropriate* responsibilities of the work, is determined not lightly to abandon the undertaking. He will persevere, until it is ascertained, whether the vast American Republic, with ten millions of inhabitants, with wealth scarcely surpassed by that of the most favoured nations, and with immensely diversified interests, growing out of those physical resources, which the bounty of God has given us, will permit this effort, devoted to the advancement of its wealth and its power, its honor and its dignity, to become abortive, with the gloomy presage that it *may* be *very long* before any similar enterprize can be successfully prosecuted.

Yale College, November 1, 1820.

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In the Text, the Roman Numeral was inadvertently omitted, before this article, and in consequence, the other articles are numbered, erroneously— i. e. Art. V. in the text, should be VI. and so on

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ERRATA.

Page 143 line 7 from top, for twenty read one hundred and twenty.

" 172 line 10 from top, for $\frac{1}{17}$ read $\frac{1}{7}$.

" 264 " 3 from bottom, for folius read foliis.

" 266 " 13 in demonstrations omit the final s.

" 282 " 6 from bottom, for Dr. Pursh read Dr. Parish.

" 338 " 4 and 14 from top, for spiculæ read spicula.*

N. B. The articles of intelligence at page 166 of this volume, were communicated merely as materials to be arranged and digested by the Editor, and not to be published in that form.

* It was spicula in the MS.

DIRECTIONS TO THE BINDER.

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THE

AMERICAN

JOURNAL OF SCIENCE, &c.

TOPOGRAPHY, GEOLOGY AND MINERALOGY.

Art. I. *Account of a journey to the summit of Mount Blanc; by* Dr. Jeremiah Van Rensselaer, *of New-York.*

TO PROFESSOR SILLIMAN.

Geneva, *July* 19, 1819.

Dear Sir,

I TAKE the liberty to send you a hasty sketch of a short tour that I completed a few days ago, including the Vale of Chamouny—and an ascent to the top of Mount Blanc. As this latter is a journey not often made, and never before by an American traveller, I trust no apology will be thought necessary.

As I have suffered much both from heat and cold, and am still labouring under an affection of the eyes and face, you will excuse such errors as may occur in orthography, &c. As to the statement, I copy it from notes made on the mount, and soon after my arrival in the Vale.

With much respect, I have the honour to be,

Yours truly,

JEREMIAH VAN RENSSELAER.

Returning from Italy by the grand road of the Simplon, which, more than his victories or reverses, will contribute to the fame of Bonaparte, we enjoyed the scenery of the

Vallais and the south side of the Lake before arriving at Geneva. We had scarcely finished with the curiosities of the place, when my friend and fellow-traveller, Mr. W. Howard, of Baltimore, proposed a visit to the Vale of Chamouny.

This delightful valley, the most elevated in Europe, and almost separated from the world, lies 18 leagues S. E. of Geneva—it is 5 leagues long, and 1-2 a league broad, and is covered during the few months of summer, with the most luxuriant vegetation. To the North, rises the chain of Red Needles (Aiquilles Rouges;) to the South the gigantic mass of Mount Blanc; to the N. E. is the Col de Balme; and to the S. W. the mountains of Lacha and of Vaudagne. The river Arve, joined by Arvieron, that gushes impetuously from beneath the glacier des Bois, flows rapidly through the length of the vale; and receives the tributary streams of the glaciers that increase its size only to augment the volume of the Rhone, into which it pours its accumulated waters. The beauty of the vale, the fertility of its soil, the innocence and simplicity of its inhabitants, and the singularity of the landscape, in which mountains of ice alternate with fields of flowers, have long drawn the attention of Travellers. Each glacier, each needle, each mountain forms a distinct curiosity, and a whole season might pass pleasantly enough in contemplating nature in her mildest and in her most chilling moods,—for she smiles and frowns alternately on the vale.

The most interesting object that strikes the attention, where every thing is worthy of notice, is Mount Blanc. The frozen glaciers, that like feet seem to support its huge mass in the air, while its snow capped summit is lost in the heavens, form a singular contrast to the green fields in which they rest. Having already visited some of the highest points of the Appennines, in traversing the ridge as it extends through the Tuscan, the Roman and the Neapolitan states into Sicily, I felt a desire to stand on the lofty mount before me, and mentioned it to my companion. The difficulty of the undertaking, the many failures, and the small number of those who have succeeded, seemed at first very discouraging—but we resolved upon the attempt and sent out for guides. These it was not difficult to procure; for as the inhabitants considered it a mark of courage and perseverance, it is ever thought an honour to have been on the summit, and is mentioned in praise of him who has happily attained the object. It was therefore difficult to choose—but we took those who had before made the attempt. The women too were to be consulted, for however anxious they might be that their sons should procure the honor, they were loth to let their husbands encounter so many perils.

In vain did the guides represent to us the dangers and privations of the undertaking—in vain expatiate on the heat, the cold, the fatigue, and above all on the many failures. We conversed with Balmat and Paccard, the two first who ascended, and having previously agreed with a master guide, appointed the next day for the ascent.

At 3 o'clock A. M. on the 11th inst. mass was said for a successful journey and a safe return, and at 5 we commenced our way—our guides preceded with the necessary articles and we followed, confident of success. For a league our way laid through fields of grain, and then commenced the woody region that extends double the distance up the mountain. Here we found ourselves at the edge of the Glacier Bossons (one of the grandest of the mount,) and for two leagues mounted near to its side. The way was painful and difficult, winding on the mountain side, and crossing streams that pour constantly from the higher regions. We had now ascended 5 leagues, and were about to quit the land; here commenced the region of eternal ice. Balmat, the veteran hero of the hoary mount, who first placed foot on its frozen summit, had thus far accompanied us: his age prevented him from ascending farther, and wishing us a safe return, he retraced our mountain path. Thus far we had followed a kind of path, but once on the snow, a bleak region extended before us,—no footstep marked the white surface—no sign of life or animation arose to cheer us. Here too commenced the dangers of the way, and we were forced to follow in regular succession :—first went a guide with two long poles to search for crevices, that we might avoid them—then followed a man with an axe to cut foot holes in the ice; then came two who changed with the above, and formed a relief: next followed a man with the ladder—at some little distance I followed tied by a rope round the waist to two guides, one of whom preceded, the other followed me—and lastly came Mr. H. tied in the same manner to two other guides. Each of the men carried a knapsack with provisions, blankets, sheets for a tent, cords, coals, a pan to melt snow in, a chafingdish, bellows, &c. &c.; and each of us was armed with a pole about 9 feet long, with a sharp iron spike in the end, to support ourselves and to prevent us from falling.—Our line of march seemed rather formidable as we ascended and descended the broken glaciers.

We encountered many crevices, some of which were distinctly seen; others more than half hid by the snow. Occasionally masses of ice had sunk, and left the remaining wall rising 40 or 50 feet above us: in such cases it was necessary to search the lowest end of the wall, and ascend by the ladder, or by cutting stepping holes in the side. This however could be attempted only where the wall was not more than 20 feet high, as our ladder was only of that length. Where besides the wall, there was a crevice at the bottom, the ascent was indeed dreadful; for while crossing a gulph that yawned 150 or 200 feet beneath us, we were climbing the ladder placed against the side of ice, where the least slip must have precipitated us to immediate death. Where the sides of the crevice were of equal height, the ladder was laid down, and we then crawled over on all fours. In a few cases it occurred that an arched bridge of snow connected the sides, and here it behoved us to tread lightly and with caution, lest breaking through, we should have sunk into a pit from which it would have been impossible to return. Often frustrated in our course by unforseen crevices and walls, we were forced to make a lengthened march; but at last clambered up a solitary rock that rises from the snow, 8 leagues from the village. It is called the Grand Mulet, and having served several travellers as a resting place, was chosen by us as the only rock on which it was practicable to sleep. It is composed of quartz, and micaceous schist rising in perpendicular lamina 60 or 70 feet above the ice, and 7,800 feet above the level of the sea. A few pieces of schist arranged into a kind of platform afford a tolerable resting place for him who is not over fastidious on such a journey. On one side rises the sharp Aiguille de Midi, and on the other the Dome de Couté, that seems to soar far above Mt. Blanc. It was yet early in the afternoon, and the sun beat down so powerfully as to render the heat very inconvenient:—occasionally however a cloud of thick mist enveloped us—it was then extremely chilling and uncomfortable. While on the grand Mulet we observed a beautiful butterfly, of the most vivid and brilliant colours, making its way towards the summit of the mountain. At 6 P. M. Reaumur's Thermometer stood at 4°,(41° of Fahrenheit) above freezing. With the aid of a blanket, and a sheet placed so as to keep off the wind we formed a tolerable tent, and lay down to refresh ourselves. Night soon closed upon us, and rendered our situation still more appalling :—the dead silence of darkness was broken only by the groans of the weary, or by the loud thunder of a fallen avalanche that roused us from an imperfect sleep.

On the 12th at 2 A. M. the guides began to make preparations, and at 3 we resumed our journey—A road had been cut for some distance the evening before, and the snow being hard, we advanced without great fatigue or danger, to the grand Plateau, a distance of 4 leagues : it is a plain, with a more gentle elevation extending about a league towards the summit. Here we rested some time, and one of the guides found himself unable to proceed. We however went on after taking some refreshment : the air was much rarefied, and the sun exceedingly warm. At the end of the Plateau began the steepest ascent :—dreadful avalanches that seemed falling with their own weight hung over our way, while fearful chasms yawned beneath us. The elevation was too great to allow us to ascend in a straight line, our path therefore was in a zigzag course towards the top, every step being cut in the ice with a hatchet. The path was so difficult and the rarefaction of the air so great, that even the stoutest guides could not advance more than fifteen steps without stopping to rest—and Mr. H. found himself so much incommoded, that we feared he would have to return. His perseverance enabled him to proceed, and at 11 o'clock we arrived at the petit Mulet, a granitic rock that just shows itself above the snow ; here some of the guides being much fatigued we rested some time. From this rock the ascent is not steep, but very fatiguing, on account of the rarefaction of the air—we however reached the summit at half past 12—and stood upon the highest point in Europe. The top is formed by a ridge running N. E. and S. W. about 12 feet above the little plain that lies to the south. As to the depth of snow upon it we are unable to form a conjecture. Bonaparte, after many fruitless attempts, succeeded in having placed here a pyramid 12 feet high. It was visible for three years, but has gradually disappeared, and has not been seen for some years. In the sun the Thermometer was at the freezing point; in the shade 3° of Reaumur below it; (25°, 25 of Fahrenheit.) A bright sun shone on us, through a vault of indigo blue, in which not a spot was obscured by a cloud. To the North, at the distance of nearly 100 miles, rose the black ridge of Jura: farther east, lay the mountains of Underwalden and of Uri;—to the east St. Gothard and the Simplon; St. Bernard and Monte Rosa seemed to stand at our side, and Piedmont to stretch at our feet.—A light floating vapour hid from us the vales of Lombardy and of France—On one side the happy valley of Chamouny lay beneath and the little village shone in the smiling plain, beset with fields and woods;—on the other the Vale d'Aoste, with her cheerful river, extended her green surface to relieve the eye. The glaciers of Bossons, des Bois, d'Argentiere and of Tour seemed sliding into the meadows—while the frozen waves of the Mer de glace seemed hushed into a calm,—and the Montanvert, with the needles of Dru, Geant, Charmoy, Midi, &c. showed their splintered pinnacles far below us. We remained an hour and a half on the small plain to the south of the crowning ridge, and here four of our guides laid themselves on the snow and slept for some minutes. We did not feel fatigued, but found our respiration much quickened and our pulse greatly accelerated; this was particularly the case with Mr. Howard who is of a fuller habit than myself. Though we had provisions, none of us felt an inclination to eat; but our thirst was great, and we found vinegar and water the most refreshing beverage. We fired a pistol three times nearly filled with powder, and well wadded; the report was that of a squib.

At 2 we began our descent with an intention to examine the different rocks that broke through the snow. The highest is about 350 feet below the summit, formed of granitic tables, that lay loose on each other, and of which feldspar is the predominant ingredient. The petit Mulet is of the same formation—and I may here add, that, to be minute would only be to give you what has already been printed.

The descent was perhaps more fatiguing than the ascent had been, and far more alarming, for we now saw the crevices that yawned beneath us; and the reflection of a bright sun from the glistening snow almost prevented us from seeing our path, the least deviation from which would have been inevitable death. Part of one of the avalanches that threatened us in our ascent, had already fallen and lay scattered over our path and the part that yet hung suspended above us seemed ready to follow its fallen half. Dreadful indeed was the silence in which, with hurried step, we hastened down the sidehill.—Fearing to raise a look from the pathway, and scarcely daring to breathe, we arrived near the bottom. The danger being now past, we turned to survey the hanging mass;—the eye was soon satisfied—and in speechless meditation we resumed our way.

At the grand Plateau we found the guide who had returned—and it was here we discovered that our thermometer was broken. It was exceedingly hot, and we rested only a few minutes to gain breath, and refresh ourselves. Thus far the ice and frozen snow had formed a good path—but the influence of a sun, now more powerful than I ever felt, had melted the snow; and after leaving the Plateau, we sunk every third step, nearly to the waist. It was of no use, to send the guides to break the way, nor to seek a new road—it was immaterial if we followed their track, or made one for ourselves—we still sunk. Our progress was further interrupted by some crevices that we had not seen in the morning—and being wide, with one side higher than the other, our ladder was of no use. At these places we sat on the snow, and slid down so fast as not to break the frail covering of the crevice. This was the most fatiguing part of the whole journey, and we were happy once more to climb the steep sides of the Grand Mulet. The sun had set upon the valley, but its rays yet beamed upon our elevated rock —its effects had been severely felt—and though scorching during the day, it seemed in pity to lend its lingering light to shorten the dreariness of the night.

Fatigue had nearly lulled us to sleep, when thinking on the last journey of the morrow, some of the guides turned to see the path by which we had ascended the day before. While yet following its traces they saw part of it lost in an avalanche—a mass had fallen in, and our road was gone. Few and unrefreshing were the hours of our repose—the cold was excessive—and some coals in the chafingdish, kept constantly enflamed by the bellows, served to keep us from freezing. Our faces pained us almost intolerably—our eyes were so inflamed that we could scarcely distinguish an object at the distance of a few feet—our fingers and toes were nearly benumbed—and the whole system disordered, not so much from fatigue as from a strange influence of the atmosphere.

Early on the morning of the 13th we began the labor of the last day's journey. Our path had been partly lost in an avalanche, and partly dissolved in the melting sun of yesterday—and we followed the track of the Chamois, that has never been known to err. With much difficulty could we discern our way, as we were nearly blind—the crape and goggles we had worn the day before, were now of no avail. We happily quitted the ice soon after the sun shot its first rays on the mountain we had left—having been forty-five hours on the frozen surface. Happy were we all, when arriving again at the woody region, we heard the tinkling of the herd—we reposed a few minutes in the shepherd's hut—and arrived at Chamouny at 10 o'clock.

We went immediataly into a darkened room—and after washing in cream, went to bed, but not to rest. Our eyelids were glued together, and our faces entirely blistered. When the sun was down, we rose for a few minutes—and again lay down. Our fatigue overcame our pain—and exhausted nature sunk to sleep:—we awoke in the morning much refreshed—so that on the 14th we came to Geneva in a darkened carriage. The skin has fallen from our faces, which are now, though raw, much better—the inflammation of the eyes is subsiding, but still troublesome and confines us to the house.

The minute and accurate observations of Mons. de Saussure have left but little for future travellers. His genius for a time seemed to reside in the Alps, and it was his delight to stand in reality or in imagination on those elevated summits from which the world seemed to lie below him. His daring spirit led him to climb the most difficult and dangerour points—and it was on one of these, the Col de Geant, that in 1788, he passed fifteen days in performing a series of physical and meteorological experiments of the most interesting nature—at the elevation of 10,578 feet above the sea. His researches on the different summits are of the same kind, and have been found accurate by the test of succeeding observations. Our ascent to the summit of Mount Blanc, then, may be considered a journey of curiosity: but it was our wish to examine the temperature and rarefaction of the atmosphere, to obtain an exact knowledge of glaciers and of the frozen region, and to survey the rocks. Our thermometer was broken the second day, when after taking the temperature at the top, we were about to notice it at stated distances on our descent. Our vessels of air from the summit were injured in sliding down the declivities or in wading through the snow.—As to the rocks little can be said of them: the nature of the mountain has long been well known, and it would be useless to enlarge upon the accounts already given. Thus our journey has been of no avail in adding to our knowledge of the rarefaction of air at the top, yet we are satisfied with having made the attempt. It may be ascertained by a barometer, which we had not, or by filling *many* vessels, so that some at least might be brought down safe.—This too would allow a portion for analysis—I know not that the attempt has been made.

Mons. de Saussure found the absolute height of Mount Blanc to be 14,700 feet: Delue made it 14,346: Prof. Pictet says it is 14,556: while M. Tralles, who has measured it three times, with the same result makes it 14,793 feet: making its absolute height 5,355 feet less than that of Chimborazo; but its relative height is greater, as it rises 11,532 feet above the vale of Chamouny, while Chimborazo is elevated only 11,232 feet above the valley of Tapia—making a difference of 300 feet relative height.

It was in 1760 that M. de Saussure seems first to have thought of measuring Mount Blanc, and offered a reward to the person who should discover a way to the summit. His offers were sufficient to induce many to make the attempt—and for twenty-five years, unsuccessfully. The most important trials are recorded as follows.

The first attempt was made in 1762 by an inhabitant of Chamouny; he failed as he only reached the glacier Bossons.

In 1775 four men, following the same route, advanced to the mount de la Cole, running parallel to the glacier Bossons.

In 1783 three others tried the same path, but were forced to return by a strong desire to sleep, which would have been fatal, if indulged.

In the same year, M. Bourrit of Geneva was driven back by a snow storm. The following year he was again frustrated by the violence of cold and fatigue.

In 1785 M. de Saussure and M. Bourrit made another attempt with fifteen guides. They arrived the evening of the second day at the Needle de la Cotè, at the elevation of 11,442 feet above the sea: the softness of the snow and their fatigue made them return.

In 1786 six men made another trial; but were forced to relinquish the enterprise. One of them, named J. Balmat, wandered from the rest, and passed the night alone on the glacier—in the morning he found himself near the top. He returned and suffered much from an affection of the face and eyes. He was attended by Dr. Paccard, and in gratitude offered to conduct him to the summit—which he did a few weeks afterwards. They found it extremely cold—their provisions froze in their pockets, and the ink in their inkhorns—they remained only a few minutes, and descended to the village in a shocking condition. Dr. P. had his hands and feet frozen—and Balmat's face was disfigured for eight days.

The same year de Saussure tried again without success. The year following he made another attempt with seventeen guides—and on the third day of his journey reached the summit. He passed there five hours in making those observations and experiments that have gained him so much and so deserved reputation. On the fifth day they returned to Chamouny.

The next day M. Bourrit made his fourth attempt, but was forced to return.

In 1788 he tried again with Mr. Woodley, an Englishman, and M. Camper, a Hollander—a storm dispersed the party, but Mons. B. with three guides gained the summit. They descended immediately. Mr. Woodley had his hands and feet frozen—M. Bourrit was forced to use ice applications for thirteen days—the guides suffered from frozen fingers and toes.

In 1790 Col. Beaufoy, an English Officer, gained the summit, and returned with the fear of losing his sight—he however recovered.

In 1792 four Englishmen undertook the task—but were forced to return—all of them much hurt. One guide had his leg broken, and another fractured his skull.

In 1802 Messrs. Forneret and d'Ostern with seven guides gained the top, and declared on their return that nothing could induce them to make another attempt.

In 1816 Count du Lusy, a Russian, ascended a little above the petit Mulet, but was obliged to return—His feet were so frozen that the skin came off with his stockings; and he was long forced to use crutches. Two of his guides were frozen nearly to the same degree.

In 1817 Count Malazesky, a Pole, gained the top with eleven guides—his nose and ears were frozen.

There have been various attempts made by persons who returned after the first or on the second day; such trials have not been recorded.

Art. II. *Account of the Kaatskill Mountains; by* Mr. Henry E. Dwight.

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE, &c.

Dear Sir,

THE following description of the Kaatskill Mountains, and of the country in the vicinity, has been delayed much longer than I intended, and is much less perfect than I could wish.

During the last summer I made an excursion to this chain, and examined the prospects and geology for several miles around the lakes. The scenery is in the highest degree beautiful and sublime, and well deserves the best efforts of the muse and of the pencil.

I have been particular in describing the variegated prospects which these mountains present, as little or nothing is known of the existence of such scenery, excepting in the immediate vicinity. Few even of those who live within a few hours ride, have curiosity enough to visit it. This scenery, including the numerous cascades, ravines, precipices, and the prospect from the top of this chain, while it afforded me much more pleasure than a view of the falls of Niagara, awakened emotions not less elevated.

I have mentioned these mountains to more than fifty persons since I visited them, but I have not met with more than five or six who had ever heard of this sublime display of nature's workmanship.

The cascades which I have described, I visited immediately after the heaviest fall of rain that had occurred within the memory of the oldest inhabitant. Some idea can be formed of the quantity of water that fell, when it is known that one mile north of the village of Kaatskill, a ravine was formed by the water directly through a wood, one hundred and ninety-five feet in breadth, by seventy-nine in depth, for the distance of nearly a furlong; when it united its waters with the Kaatskill creek. As I was on the mountain at the time, I took the opportunity to visit these cascades early the next morning, and have described them as they then appeared. Probably they will not appear to those who visit them in the summer season, to be adorned with all the lustre which they exhibited at this time, but if seen in the spring, or after a heavy shower, they, with the scenery around them, will produce an effect on the mind of the beholder, which will bid defiance to all description.

With much respect,

I am, &c.

HENRY E. DWIGHT.

New-Haven, Dec. 20, 1819.

Geological and descriptive account of the Kaatskill Mountains and of the vicinity.

The town of Kaatskill is situated on a creek bearing the same name, one mile from its confluence with the Hudson river. This river is remarkable for the high banks which bound it, exhibiting for 150 miles nothing like an interval. These banks vary in altitude from 20 to 400 feet, presenting every variety, from steep hills to perpendicular precipices. Most of this extent, with the exception of the Highlands, is of secondary formation. Between this town and the river, a hill rises to the height of 150 feet, forming the western bank of the stream at this place. The bank is washed by the Hudson during the freshets in the spring, presenting a view of the rocks which compose it. These rocks which are Wacke, vary in appearance, exhibiting a solid and compact mass; again they are stratified, and often approximate to argillaceous slate. The strata vary from an inclination of a few degrees, to a horizontal position, and have their fissures filled with veins of Carbonate of Lime, of a white colour, translucent, and presenting a fine crystalization. The Wacke varies in colour from light to dark brown, frequently resembling indurated clay. Ascending the hill, veins of Flint, Hornstone and Pitchstone appear on the surface, or in veins in the Wacke. The Pitchstone is of a black and dark green colour, and more abundant than the Flint or Hornstone.

Petrifactions.

On the Kaatskill creek three miles above the town, is a cascade of about 20 feet in height. South of this fall, the rocks which form the bed of the stream, run parallel with the current and are composed of Carbonate of Lime. They are partially composed of petrifactions of the clam, entrocite, &c. The entrocites vary in length from one to six inches, though they sometimes exceed this. I saw imbedded in one of the rocks, one of fifteen inches in length. They lie on the surface and in an oblique and right angled position. As these petrifactions are siliceous and the matrix limestone, they rise above the surface, owing to the greater attrition of the rock. The entrocites commonly appear straight, and resemble vertebrae united to each other. Sometimes they assume a twisted appearance, as if struggling to escape when first imbedded. I observed here several pieces of Madrepore adhering to the rock, or imbedded in it, weighing from ten to twenty pounds. In these rocks are veins of Flint, of several inches in width, partially covered with crystals of Quartz. The rocks forming the bed of the stream appear to have been rent asunder, leaving cavities of several feet in breadth, and ten in depth, in which, when the stream is very low, most of the water runs.

Diamond Hill.

At the termination of Main-Street, on the bank of the creek, is a small elevation called Diamond Hill, from the great number of Quartz crystals found in it. The rocks which compose this hill, bear a strong resemblance to those in the hill between the river and the village, only they are more stratified. In these rocks several feet below the surface, are many cavities partially filled with a black mud. In this mud, large quantities of these crystals are found, varying in size from a pipe stem, to several inches in diameter. These crystals are commonly imperfect, presenting a surface with several sides polished. They usually have cavities in them, partially filled with mud, probably owing to the particles when in a state of solution, not being near enough to attract each other. Several crystals containing water in a fluid state, have been found in this hill. This water appears in a cavity in the crystal, which is filled with this fluid and air. I have one found here, in which, by changing its position, the air will rise in the tube, causing the water to descend. In number IV. of the "American Journal of Science" is a description of a crystal of this kind, found in this hill. Professor Dewey who describes it, supposes the liquid to be *naptha*, from the fact that the "fluid did not freeze." I have seen several crystals from this hill of this kind, and as far as I could form an opinion from the appearance of the fluid as seen through this transparent medium, I have supposed it to be water. As these crystals lie in a black mud several feet below the surface, it would seem improbable that Naptha should have been found mingled with it, particularly as the rocks around it bear a strong resemblance to argillaceous slate. This oil is rarely if ever found pure, and when pure is usually associated with Carbonate of Lime. A specimen of this kind belonging to a friend of mine, when exposed to an atmosphere 6° or 8° below zero of Fahrenheit, congealed. As the water filled most of the cavity, it expanded during congelation, so as to burst the crystal, and the liquid which had every appearance of water evaporated. The fate of the crystal was not known until some time after the evaporation of this fluid. The large crystals are seldom transparent, owing to the mud and riffs beneath the surface. Those of a small size are generally transparent and perfect. The common form is a six sided Prism, terminated at each end, by a six sided pyramid. These crystals are frequently irised, presenting all the colours of the Iris, owing to the fissures under the surface. I have seen several specimens of Twin crystals that were found in this hill, united to each other at one of their edges.

Between the village and the mountain, the country is altered in its appearance. Near the western end of the bridge, which crosses the Kaatskill at the village, a hill rises to the height of 150 feet. The rocks which compose this hill are much more compact than those near the river. They have a dark blue colour and bear a much stronger resemblance to trap. Half a mile west of this, a ridge of land rises to the height of fifty feet, when the country changes to Carbonate of Lime. These rocks are compact, and filled with petrifactions of the clam, entrocite, &c. often in so great quantities as to compose one sixth of the rock. On the surface of the Limestone tract, I observed several specimens of red Jasper.

Sulphurous Spring.

On the bank of the Kaaterskill (in the limestone region which is about four miles in breadth,) there is a sulphurous spring,* which is covered by the stream when the water is high. The water of this spring is so strongly impregnated with sulphur, as to alter the colour of the stream for some distance after its union with it. It has a strong sulphurous taste, several rods below the junction of these waters. When the stream is low the atmosphere around the spring is strongly impregnated with the odour of Sulphuretted Hydrogen Gas. I have been informed that a large piece of native sulphur was found near this spring a little below the surface.

Slate and Sand Stone tract.

Two miles from the base of the mountain, the Limestone region terminates. Sand Stone immediately appears. The earth here assumes a more reddish appearance, and continues of this colour to the mountain. The sand stone terminates at the base of the mountain. As you ascend the mountain, Slate begins to appear resting upon the sand stone below, varying in its strata from nearly horizontal to an angle of 30°. It contains too much argil to be useful in building, and after exposure to the air is easily broken. The region

* I learned the facts relative to this spring from a Gentleman who had often visited it. The waters of the stream were so high as to prevent my examining it when I last made an excursion to the Kaatskill Mountains.

of Slate continues one third of the ascent, when Sand Stone again appears, resting upon it. The colour of these rocks is a dark varying to a light brown. They are darker and much more compact than those near the base. On the peaks of these mountains, are many specimens of Conglomerate or pudding stone. I observed a rock of this kind (on the peak north of Round Top,) of half a mile in length, and from eight to ten feet in height, forming an immense band to the mountain. The pebbles imbedded were from the size of a bullet, to that of a six pound shot. There are no Limestone rocks on these mountains. The inhabitants have to bring all their lime from below. I saw a specimen of carbonate of Lime, similar to that near the village, and partially filled with petrifactions, several miles west of the conglomerate rock. As it was lying loose in the road, and as the rocks around it were either quartz or sand stone, I prèsume it must have been carried up the mountain by some of the inhabitants.

The scenery of this mountain is probably not surpassed by any in the United States. The narrow glen, the deep ravine, the lofty precipice and the glittering cascade, combining the sublime and beautiful, excite the highest interest in the mind of the spectator.

There are two roads leading up the mountain, one through the Kaaterskill clove, the other is cut in a serpentine direction up the side of the mountain. The most interesting ascent is through the clove or cleft in the mountain, which appears to have been formed by some great convulsion of nature.

Kaaterskill Clove.

This Clove is formed so as to present a descending ravine, for five miles in length, in which the Kaaterskill pursues its way from near the top of one of the peaks to the base of the mountain.

The road runs on the sides of these mountains, following for several miles the direction of the stream, above which it is elevated from twenty to several hundred feet. After running on the north side of the Kaaterskill for about a mile, it crosses it and rises two hundred feet above the stream.—Standing at this place, as the spectator casts his eye beneath him, he beholds the water forcing its way over a bed of rocks, or obstructed in its course by some rock precipitated from above, rushing around it with great impetuosity, now descending a rapid or precipice with a hoarse thunder, or stealing gently along with an uninterrupted current. On the opposite side of the stream, the rocks rise at an angle of 70° about *five hundred feet* in height, when they lift their heads five hundred more, presenting a precipice of salient and reentering angles looking like the rude bastions of a natural fortification. The road for about a mile runs on the south side of the stream, which it then again crosses and continues on or near it, until it reaches the top of the mountain. As you turn your eye towards the east, you behold this ravine five miles in length, bounded by eminences of several thousand feet in altitude, forming a vista of mountains, peak after peak projecting into it, through which a part of the counties of Greene, Ulster, Dutchess and Columbia appear variegated with hill and dale, their cultivated fields and dark forests adorning the back ground.

Western fall of the Kaaterskill.

At the termination of this ravine, a short distance from Parmaters, is a cascade of great beauty, formed by the waters of the main branch of the Kaaterskill. This stream is formed by the union of two branches, one rising in two lakes about one and a half miles east of this cascade, the other about half the distance in a northerly direction. The best view of this fall is from below, the foliage above being so thick as in a great measure to obscure it. Below the fall the banks of the stream, which are nearly three hundred feet in height, rise almost perpendicularly from the surface of the water. I visited it during the last summer, (1819) a few hours after a very heavy rain. In company with my friend E—— I descended the bank, which, owing to the shower, was very difficult. The rocks were either loose or covered with moss, which, wet with the rain, prevented us from obtaining a firm foothold. In many instances we were saved from a fall of many feet, by grasping some neighbouring twig, which, if it was not pulled up by the roots, served at least to stop us till we could discover firmer ground. We stationed ourselves near the foot of the fall, where the view amply compensated us for the difficulties we had encountered. The stream, which was then fifty feet in breadth, descended in the form of a rapid for some distance above the precipice, when, reaching it, it presented a perpendicular fall of 120 feet; then striking on a rock, which makes an angle of 40°, it rushes down this rock, enveloping it in foam. The water fell in such a manner as not to strike the precipice, but formed a plane parallel to it. A number of shrubs rooted in the crevices of the rocks which form the precipice, appeared through the fissures of the stream, waving their green foliage with the wind, which was very great, owing to the suction through these parallel planes.

The rocks on each side of the stream project so as partially to eclipse the sides of the fall. They have fallen from time to time, in such a manner as to form seventeen natural steps rising one above another. We stationed ourselves on these steps, to enjoy the scenery around us. Before us the stream fell in a beautiful sheet, exhibiting its transparent waters, when, striking the inclined plane, it rushed down it with headlong fury, bearing on its surface a foam of silvery whiteness. On the right and left, the banks rose over our heads in silent grandeur, as if on the point of detaching their projecting masses into the ravine where we were standing; while below us the water was visible for about thirty rods, descending in the form of a rapid, when bending around the point of a projection of the mountain, it disappeared from our view. The spray was so thick as to make a dense cloud, on which the sun shining with great brilliancy, and being nearly vertical, imprinted a perfect rainbow. This bow, which was not more than eight feet in diameter, formed a circle around us slightly eliptical, near the centre of which we stood. As we approached the fall, the spray thickened, the splendour of the colours increased, and the shrubs, the rocks, and the water, were tinged with its choicest hues. To complete the view, a small rivulet, caused by the late rains, fell about two hundred feet, in the form of a cascade, down the precipice, on the southern bank of the stream, displaying its crystal waters through the green foliage which adorned it. We remained here enjoying the prospect for some minutes, when, drenched with spray, we reluctantly bade it adieu, with all those emotions which the sublimity and beauty of such a scene would naturally awaken.

Elevation of the Kaatskill Mountains.

These mountains vary in height from 2500 to 3800 feet, as ascertained by Capt. Partridge, who measured them by the barometer. Round Top, which is the highest of these peaks, can be seen much farther, and to the eye appears much higher than Saddle Mountain at Williamstown, which has been often measured, and found to be about 4000 feet in height.

View from the Mountains.

The view from Round Top, which rises south of the ravine, is superior to that from any part of this chain, comprising a greater extent, particularly towards the west. I have never climbed this peak, but have often ascended that immediately north of it, and shall describe the prospect from this eminence as it appears in August. Before you, the counties of Greene, Columbia, and Dutchess, expand towards the east, presenting to your view a variegated carpet, checquered with forests, groves, and orchards, and blooming with all the luxuriance of that season. Beyond them, the states of Massachusetts and Connecticut are spread towards the horizon, till they finally intersect it. Beneath are many undulations, where the vallies and hills, glowing with cultivation, exhibit all the varieties of green and yellow, which an approaching harvest presents to the eye. In the middle of this area, the majestic Hudson rolls its glittering tide for more than one hundred miles, ornamented with towns, cities, and villas, along its banks, while its bosom is covered by many a vessel, spreading her canvass to the breeze. At the distance of forty miles, Mount Washington "swells from the vale" to the height of 2500 feet. On the south, the Highlands, at a greater distance, lift their peaks to nearly the same elevation above the Hudson, which rolls between them; while Saddle Mountain, at Williamstown, at the distance of sixty miles, looks down in proud magnificence upon the vale beneath it. North of this, the Green Mountain range extends for fifty miles, "Alps rising on Alps" till they melt away in the horizon, where the view is terminated. The diameter from north to south is about 150 miles, embracing the most opulent part of the state.

View in a fog.

In the autumn, a dense fog commonly arises during the night, from the streams within the view, covering with its misty waves the whole area, excepting the tops of these lofty mountains. The only land visible, is Saddle Mountain and the Highlands, each sixty miles, and the Taughconnoc Mountain, at nearly the same distance. The fog rises about 1500 feet in height, and is gilded by the beams of the morning sun as it appears above the horizon. For an hour after sunrise, the mist is quiescent, exhibiting an almost shoreless ocean, with the tops of these peaks rising above it, like distant islands in a calm at sea. After the sun has risen a few degrees above the horizon, the fog begins to be agitated, and to move in vast undulations towards the heavens, shooting its needles into the atmosphere, or rolling its lengthening billows into a thousand figures, presenting a glowing picture of the general deluge. It remains agitated about an hour, when, unfolding its misty mantle, the earth below appears here and there illumined by the rays of the sun. When the fog is dispelled by its beams the landscape unfolds all its beauties, as if it had just sprung into existence at the command of the Creator.

Lakes.

One mile west of this peak are two lakes, uniting with each other by a small outlet, over which the road passes. These lakes are each of them about three-fourths of a mile in circumference, and are the source of one of the branches of the Kaaterskill. They are, as I have been informed, more than 100 feet deep in the centre, and abound with several kinds of fish. The outlet to these lakes is the commencement of the stream just mentioned, which forces a passage over the rocks. Here it arrives at a precipice about one mile from the south lake, over which with a rapid current it descends, making a beautiful fall of between two and three hundred feet. I have often seen this cascade in the summer season, when the stream is much reduced. The best time to view it is in the spring, when the snows are dissolving, which swelling its size and increasing its current, add much to the beauty of this fall.

Eastern fall of the Kaaterskill.

I visited this cascade immediately after viewing the western fall on the Kaaterskill, when the column of water was swollen to eight or ten times its common size, and shall describe it as it then appeared. The rock over which the water descends, projects in such a manner that the cascade forms part of a parabolic curve. After striking a rock below, it runs down an inclined plane a few rods in length, when it rushes over another precipice of one hundred feet. The column of water remained entire for two-thirds the descent, and its surface was covered with a rich sparkling foam, which, as it fell, presented to the eye a brilliant emanation. Here it was broken, and formed a continued succession of showers. Large globules of water, of a soft, pearly lustre, enriched with a prismatic reflection, shot off in tangents to the curve of the cascade, and being drawn by the attraction of gravitation, united again with the stream. The sun shining through a clear atmosphere, imprinted on it his glittering rays, appearing like a moving column of transparent snow. The spray rising to the height of several hundred feet, was continually agitated by a strong wind, which gave birth to a number of rainbows. They were elevated one above the other, and increased in brilliancy towards the base of the cascade, where, as well as at the lower fall, an Iris spread its arch of glory, tinging the rocks and foliage with its brightest colours.

The ground below these cascades continued descending at an angle of 45°, forming a hollow like an inverted cone, of one thousand feet in depth. This was lined with lofty trees, whose verdant tops, varying from the dark hemlock to the light maple, were bending with the wind. Through this waving forest the cascade appeared at various distances, sparkling with the rays of the sun, and forming a fine contrast to the sombre rocks which surround it. From this cavity, at the distance of several miles, a peak rose to an elevation of two thousand feet, while the mountains on the right and left, impressed their bold outlines on the sky beyond them.

The best view of this scene, is a few rods from the base of the lower fall. These cascades are both of them in a direct line, and by standing in this position can be united in one. By raising your eyes, a fall of four hundred feet appears precipitated from the precipices above, apparently ready to overwhelm you, while the rocks above overhang the abyss in wild sublimity, threatening you with destruction.

A few years since, I visited this spot in company with a number of gentlemen, and lodged on the mountain. Several of our company left us, early in the morning, to hunt the wild game on a neighbouring peak, and agreed to meet us at the fall. They arrived while we were at the foot of the lower cascade, and to apprise us of their approach, discharged one of their fowling pieces. The cavity was immediately filled with the sound, which resembled the discharge of a small cannon. The report went from peak to peak, each one rolling back the thunder ere the last echo had died upon the ear, until having given from ten to twenty distinct reverberations, it passed away, leaving no sound but the roar of the cascade.

Column of Ice.

The appearance of the upper cascade in the middle of winter, is very interesting. The rock over which the stream descends, projects in such a manner, that the icicles which form in that season, meet with no interruption in their descent towards the base of the fall. The water which strikes the rocks below, begins to congeal and rise (between the column of water and the rock,) towards the icicles above. These project towards the base, increasing in magnitude from day to day, while the column from below is greatly enlarged by the water and the spray, which immediately congealing, in a short time surrounds the stream. A column of ice, resembling a rude cone, of between two and three hundred feet, is thus formed, through the centre of which the stream pours its current, dwindled, by the congelation of its waters, to one-tenth its common size. When illumined by the rays of the sun, it presents a transparent column glowing with brilliancy, reflecting and refracting its rays in such a manner as to present all the colours of the prism. It remains some weeks, a striking example of the power of hoary frost, when, partly dissolved by the genial warmth of spring, it falls, scattering its thousand fragments on the rocks around it.

Stony Clove.

About six miles west of this fall is a gap in the mountain, called the Stony Clove. This cleft is formed by two mountains meeting at their base, and rising so as to form a very acute angle. The passage through it is about one and a half miles in length; the mountains on each side rising in rugged grandeur, to seven hundred feet. They have detached their huge masses into this angle, so as to fill it to the height of many feet. At the termination of this cavity the mountains recede from each other, forming a plane which is filled with water by the melting of the snow, and by the numerous springs which rising in these peaks, pour their waters into it. The Lake which is thus formed is of considerable depth, and about half as large as those before mentioned. On the surface of this lake, a grass is growing with a great number of strong roots, which intersect each other. They are so twisted as to bear the weight of a man. It wanted only a slight display of art to give us a forcible idea of the floating gardens of Mexico. By jumping up and down several times upon this grass, it will commence an undulation around you, which motion being continued for a few minutes, will cause an extent of more than an acre to move, like the waves of the sea. Our guide informed us that he visited this lake a few months before with a companion, who, in making this undulation, jumped so high that when he struck the grass, the roots below broke, and let him partly through into the water. He saved himself by extending his arms. He was rescued by his companion from this situation, rendered peculiarly dangerous by the existence under the water, of a quick mud of great depth, which yields to a slight pressure. This anecdote together with the difficulty of reaching the grass, induced us to depart without trying the experiment. This gap in some seasons of the year, is much frequented by wolves and bears, which find it a safe retreat in consequence of the difficulties of the passage. They have their dens in the caverns formed by the rocks which have been precipitated from the precipices.

Mink Pot.

On the east branch of the Schoharrie river which rises in these mountains, is a rock with a large hole in it. This cavity is shaped like a pot, much larger a few inches below than at the rim. It is near the surface of the water, and is overflowed by it during a freshet. I did not visit it during the few days I passed on the mountain, and shall therefore describe it as I heard it from one who formerly resided on one of the peaks of this chain. It is called by the hunters, " the Mink Pot" from the following circumstance. In the spring the river is so much swollen by the rains, as to fill this cavity with water. The fish of the stream go into this cavity owing to the great depth of water, and when the stream subsides, those of them that happen to be in it are confined until the next freshet. The Minks as soon as the waters have subsided, in order to indulge their appetites, leave their abode among the rocks and come to this pot. As soon as they have arrived, they jump in to prey upon the fish. If they remain after the waters have fallen a few inches below the rim, they are as effectually imprisoned as their prey. The hunters often visit this place to take the minks. This is done by striking them with a small club, as they come up to the surface of the water to breathe. Several of these animals have, in the course of a few minutes, been killed in this manner.

Trees.

These mountains are covered with trees, which are of different kinds at the base from those on the top of the mountain. As you leave the Hudson, and proceed towards this chain of mountains, the trees which grow spontaneously are principally the black and white oak ; the former used for timber, the latter for its bark. Hickory or walnut, chesnut, butternut and several kinds of pine, are found interspersed among the oaks. These seem indigenous to the soil, but do not grow as abundantly as the oak. On the hills bordering the river, and for some distance back are many cedars of a small size, the soil being usually so thin, as to prevent their taking deep root. Elms, iron-wood, and white birch, and in the swamps a wood called swamp ash, are thinly scattered among the trees before mentioned. Maple, beech and hemlock, do not often grow below the mountain, but as soon as you ascend, these trees make their appearance. The two first on the sides of the mountain are more abundant; but as soon as you cross the ridge in the serpentine path which leads to the lakes, the evergreens are very numerous. The hemlocks here, and still more on those peaks farther west, are very large, and rise to a great altitude. The spruce and the white pine, are visible in a thicket soon after crossing the ridge just mentioned. Around the lakes, and for several miles west of them, a tree which is usually called the Silvery Fur, and sometimes the balsam, is very abundant. This tree is much admired for its beauty, and often procured to adorn the grounds of the opulent. I have never observed any which had the rich silvery lustre, or grew to the same elevation, with those near these bodies of water. The soil appears peculiarly adapted to the growth of these trees, some of which are fifty feet in height.

Several miles west of the ridge, the evergreens are less frequent, and do not rise to as great an elevation, as those near the bodies of water just mentioned. Still they appear intermixed with the maple, beech, birch and ash, which rise to a great elevation. Most of the vallies which lie between the ridges of these mountains, are covered with hemlock, with birch, beech and cherry trees scattered among them. For some distance up the sides of the ridges and peaks, the hemlock continues, but near the top the hard woods are the most numerous. Along the currents of water which are very abundant on these mountains, the hemlock is generally found, and if the peaks (which often rise almost perpendicularly from these streams) are not very elevated, this tree usually continues to the top of the ascent. The tops of those ridges and peaks which are very elevated, are covered with moss and with many thickets of spruces, which are often so dense as to be almost inaccessible. Some large oaks are found near the tops of the peaks, but at this altitude most of the trees are much diminished in their size. West of the lakes the hickory, white oak and chesnut, which are abundant on the eastern side of the ridge, are seldom if ever found.*

Shrubs.

Below the mountain and east of the lakes, the whortleberry grows in great abundance. West of them they are very rarely if ever found. I ascended the peak near which the lakes are situated, on the first of October, 1816, and found them just beginning to be ripe. The laurel is very frequent on the eastern as well as the western side of the ridge. With this exception, the trees and shrubs which are numerous on the eastern side of the mountain, are seldom if ever found west of the ridge, nature having drawn this ridge as a boundary or dividing line between her productions.

Strawberries ripen here, about one month later than at the base of the mountain. This fruit is succeeded by the black and red raspberry in great profusion. As soon as these disappear, the high blakberry succeeds them in great abundance. These fruits are indigenous to the soil, always springing up after the woods have been cleared and the trees burned. They are of a fine flavour, having as much sacharine matter as those which grow several thousand feet below. The Juniper berry is in many parts of the mountain very abundant. Deer, in the winter season, when the vines and small shrubs are covered with snow, find this their only food.

Streams.

The principal streams which rise in these mountains, are the Kaaterskill and the Schohariekill, which are formed by numerous branches. The former, before it reaches the base of the mountain receiving additions from eight or ten tributaries, the latter from as many as twenty. These streams rise within a few miles of each other, the Kaaterskill descending the mountain in an easterly direction and joining the

* For this description of the trees and shrubs, I am much indebted to my friend W. W. Edwards Esq. of Hunter, New-York.

waters of the Hudson at the village before mentioned. The Schohariekill after descending from this eminence, runs in a northerly direction, and unites with the Mohawk about fifty miles from its confluence with the Hudson. Hence the waters of this stream, which originate within three or four miles of those of the Kaaterskill, run about one hundred and fifty miles before they unite with them in the Hudson. The water composing these streams, as well as the numerous springs which rise in every part of these mountains, are remarkably pure and pellucid. The sweetness and purity of these fountains cannot escape the observation of the spectator. They have the same soft lustre and transparency, that are so strikingly displayed in the waters of Lake George; and would, if covering as large an extent, present the same brilliant emanation, which the surface of that beautiful sheet of water always exhibits.

These mountains, when sailing upon the Hudson, appear to rise in the form of a ridge, and then to descend with nearly as great a declivity. I was much struck the first time I made the ascent, to find that instead of descending immediately as I had supposed, they presented a level for some miles, somewhat undulating, with here and there a deep ravine, when a succession of peaks rose one above another, as far as the eye could reach. Along the banks of the Schoharie, are intervals of considerable width, when the hills ascend at an angle of from 3° to 8° for several miles. The low price of these lands, has induced many persons to remove to these mountains, and this level has been laid out into a town called Hunter, which at this time contains from six to seven hundred inhabitants. This land is very luxuriant the first year or two after it is cleared, owing to the vegetable mould on the surface. The intervals on the Schoharie, produce good crops and if manured would be very productive. The town which is about 2,000 feet in height, does not exhibit that thrift and improvement which might be expected, as most of the inhabitants spend much of their time in converting their trees into lumber. This is easily effected, as there are more than fifty mill seats in the town, which are supplied sufficiently with water, to run a saw mill most of the year.

The peaks of these mountains are covered with snow about one month longer than the lowlands immediately beneath. The summer is usually a little shorter, and vegetation several weeks later; but when spring commences, it is more rapid than near the Hudson. The winters are so severe, and the frost so late, that peaches and several other fruits which grow luxuriantly near their base, will not arrive at perfection at the height of 2,000 feet. The fruits which grow here, as well as the vegetables and grain, are from three to four weeks later, in coming to perfection, than near the village.

The atmosphere of this mountain is very salubrious, as a current is blowing through some of the ravines, or from some of the peaks, during most of the year. This ventilation during the months of July and August, renders these mountains a fine retreat from the intense heat which is frequently experienced at their base. This salubrity is so great, notwithstanding the intense cold experienced during the winter season, that between January 1st, and the 28th of November, there had been but three deaths in a population of one hundred families.

Wild Beasts.

These mountains abound with many wild beasts, some of which during the winter season, when they find it difficult to procure food, are dangerous. Bears* are often met with in the wild passes and cloves of the mountains. These animals are hunted down by the inhabitants of the town, and only when exasperated, or destitute of food, will they venture to attack a man. Panthers are seldom seen at this time, though a few years since, they were numerous. They are very ferocious, and are not dispatched without great difficulty. The inhabitants relate to the stranger who visits this mountain, such heroic achievements in Panther hunting, as, if true, ought to entitle the victor to such a niche in the temple of fame, as General Putnam acquired by his contest with the wolf. Deer are found here in great numbers, and are hunted at certain seasons of the year, but they are less numerous than formerly. To prevent their extermination in this state, the Legislature have enacted a law, making it a penalty to kill them during the summer months.

* The guide who accompanied us to Stony Clove, has, since that time, as I have been informed, caught in a trap placed at the entrance of this clove, three bears and a wild cat.

Wolves a few years since were very abundant, destroying the sheep of the inhabitants. They are disappearing rapidly, as there is a reward of eighty dollars paid by the state and county for every one killed. Foxes are found here in great numbers, and often hunted with success. Wild cats are not unfrequent, and are often very furious. In a few instances the Hedge Hog has been caught, armed with quills of from three to five inches in length. Minks and the martin are found in some parts of the mountain in considerable numbers. These are the principal beasts that are of any size. Small animals which usually frequent our woods, are found here in abundance.

The length of this chain from north to south, is twenty miles, when it turns towards the west, and extends in that direction still farther. As far as these mountains have been explored, they present a rugged surface, peaks rising on peaks in endless succession. Between these heights of land, is usually found a deep ravine, through which some stream fed by the numerous springs in this elevated region, pours its pellucid waters, exhibiting its brilliant surface through the gloomy umbrage which surrounds it; or occasionally appearing to view, it gives life and motion to the wild sublimity which is so strikingly visible in these mountains. The scenery which I have described, may be considered as a fair representation of those parts of this chain, where the foot of man never wandered, and where no eye ever rested, excepting His who " hung the earth upon nothing," and adorned it from the stores of his magnificence. The scenery on the Plaaterkill, and that through the clove bearing the same name, I have been informed is not inferior in sublimity to that I have described. Many parts of this chain which have been explored by the hunters, are described by them as exhibiting the bold bluff, the tremendous precipice, and the awful chasm which so strongly mark the sublime.

The Botanist would find a rich repast in exploring these mountains, as they abound in medicinal plants and in wild flowers. With the hope that some individual conversant with this science, will ere long explore these Alpine peaks, I will conclude the account of these mountains, already lengthened much beyond my original intention.

Art. III. *On the Prairies and Barrens of the West; by* Mr. A. Bourne.

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE, &c.

Chillicothe, (Ohio,) *July* 30, 1819.

Sir,

HAVING seen in the second number of the American Journal of Science, an essay on the Prairies and Barrens of the West, by Caleb Atwater Esq. wherein he attempts to prove that the Prairies and Barrens were wholly formed by the agency of water; and in the fourth number of the same Journal some remarks on the origin of Prairies by Mr. R. A. Wells, by which he attempts to prove that the Prairies and Barrens were wholly formed by the agency of fire; I was induced with a view of conciliating these contrary opinions, to make a few observations on the situation, varieties, and the probable causes of the formation of natural meadows.

1. The salt meadows or marshes, which skirt the tide-waters of the Atlantic Ocean, particularly in the eastern part of Massachusetts, have evidently been formed by the agency of water.—Because they are all nearly level, sloping a very little towards the water, from which their surfaces have but little elevation, wherever they are found.

They are covered with a peculiar kind of grass, which is from six to twelve inches high, of a reddish colour and grows very thick; the roots of which, form a very compact turf or sward, and it requires a sharp instrument and considerable force to cut it. They are covered by the salt water a few inches deep several times in a year by the spring tides, and this appears to be necessary to their existence, or peculiar character: for if the water is kept from them by dykes, the upland grasses take root, the turf moulders away, or loses its tenacity, and in a few years their appearance is completely changed.

As the surface of these meadows lies a little above common high-water mark, there is generally a slope of about six feet in two or three rods, to low-water mark; and this slope is covered with a coarse tall grass called sedge, which requires a partial inundation every tide, or twice in twenty-four hours to bring it to maturity.

2. Adjoining the salt meadows, on the same level, and at the farthest extent which the salt water flows at spring tides, *fresh* meadows commence, by an almost imperceptible line of distinction; and they generally extend to the upland, but sometimes there is wet ground covered with bushes or a swamp between them and the upland.—These meadows are wet and soft, and few will bear a waggon.—They are sometimes found several miles from any salt meadows or salt water, and generally at the heads of rivers, where the face of the country is level. The general appearance of all these meadows is the same: being covered with wild grass of different kinds from twelve to thirty-six inches high, according to the quantity of water in the soil of the meadow; and the more water there is, the coarser and taller the grass will be, until flags and rushes take its place.

These meadows are much lower than the upland, and were evidently formed by the agency of water; which has deposited an alluvial soil, composed of the firmer particles from the upland, and decayed vegetable substances.

If they are drained by a large ditch round them at the foot of the upland and one through the lowest part of them, so that the water from the upland may soon run off; then the same meadows become hard, will produce cultivated grass, and even trees; and will in a few years lose all their former features except their comparatively low and level situations.

3. The Prairies of the Western country seem to me to exhibit the same general appearance as the fresh meadows east of the Alleghany mountains, and evidently were formed in the same manner.

The prairies are generally found in the level parts of the country, on the banks of small rivers and creeks, and frequently extend to their sources. They are level, generally wet and soft, and are covered with a tall wild grass.—They are much lower than the upland; and when well drained by ditching, they will produce cultivated grasses, grain, and trees; and exhibit every appearance of level upland, except their comparative depression and greater fertility.—The prairies of the west are much richer and more productive than the fresh meadows of the east; because the upland near them is richer, consequently the alluvion of the prairies will be deeper and finer; and the climate is warmer, and more favourable to spontaneous productions.

It is not impossible for prairies to be formed on the sides of mountains near their tops, like the glades on the Alleghany mountain; because there may be shallow hollows on the sides of mountains, lying nearly parallel to them, and so formed as to contain so much water from rain and the springs above them, that trees will not grow in them; and in process of time a quantity of alluvial soil from the higher parts of the mountain and from leaves and other vegetable substances will be accumulated in them, so as to reach the surface of the water, then particular kinds of grass will grow, and the hollow will exhibit every appearance of a natural meadow.

4. The Barrens, so called from their sterile appearance, are found on the high plains in the west parts of Ohio and Kentucky, in Indiana, Illinois and Missouri.—They have features in common with the prairies, but are essentially different in many respects.

They occupy the highest part of the country, and are generally level; some of them are uneven, but I have seen none hilly.—They are generally poorer than the timbered land in their vicinity, but some spots in them may be richer. They are spotted with innumerable groves or clusters of stinted oak and hickory trees, of about half the size which the same kind are on the timbered land.

The soil is not a recent alluvion like the prairies; and if it is not primitive, it is at least as old as any other parts of the great western valley. I think it must be evident to every one who will view the barrens attentively, that their present appearance was caused by fires, which have consumed the trees and the acorns from which they grow: because many of the trees that are standing are partially burnt, and almost every one that is lying down has been burnt more or less. The surface being generally level, the rains make them wet or moist three fourths of the year, and the warm climate urges a spontaneous production of wild grass and weeds somewhat similar to that of the prairies. The fires in the barrens are generally kindled by the Indians for the convenience of travelling over the smooth surface, to enable them to approach game without noise, and also to insure a good crop of grass for the next summer.

Fires sometimes escape from the camps of travellers in the dry season, and burn until the rain or some other cause puts them out.

When the white people settle on the barrens or near them, the Indians recede, fires are seldom seen, a young growth of trees, healthy and vigorous soon springs up, far superior to the stinted growth which the frequent fires have scorched, and the barren assumes the appearance of a timbered country.—That the barrens are frequently burned, and that when the burnings cease, a young, vigorous growth of trees soon springs up, are facts which can be attested by the most respectable people in this country.

Small prairies are sometimes found in the barrens, and the prairies near the heads of creeks are so blended with the barrens in many places, that it is difficult to determine where the one ends or the other begins.

5. Whatever may be said by Mr. Atwater or Mr. Wells, to prove that prairies and barrens were formed by the same agent, I shall take the liberty of differing from them both; for in my humble opinion, the difference in the situation, appearance, and structure of these natural meadows indicates in the strongest manner, that they were formed by different agents.

Mr. Wells says that, "where the grass has been prevented from burning by accidental causes, or the prairie has been depastured by large herds of domestic cattle, it will assume in a few years the appearance of a young forest."

If the low wet prairies are not burned, but pastured by cattle, will they become forests? If they are now too wet to produce trees, when were they dry enough to produce them? I say never; and that the same cause that made them prairies will keep them such: but if the water is effectually drained from them, they may produce trees.

Mr. Atwater's views of the Geology of the Western country, I think are hardly tenable; for he says that the lakes Erie and Michigan once emptied themselves into the Ohio and Mississippi rivers through the Scioto, Miami and Illinois rivers; that the barrens in Ohio are elevated from fifty to one hundred feet above the level of the Scioto river; that the whole descent of the Scioto may be one hundred feet;

that the Ohio river in a freshet is on a level with Lake Erie; and that the course of the outlet of the Lakes has been changed by the wearing down of the bed of the Niagara river several hundred feet: but the surface of the water just above the fall of Niagara, by the best modern measurments, is not yet fifty feet lower than the top of the slope near Queenstown, where it is generally supposed the wearing began.—Our citizens express a great anxiety to become the founders of new systems and theories to account for the surprising phenomena which they discover in the structure of the western country. But perhaps it would advance the progress of science and general knowledge as much, to examine facts carefully, and report them to posterity faithfully, without bending and twisting them to prop up imperfect theories.

I am, very respectfully,
Your humbe servant,
A. BOURNE.

FOSSIL ZOOLOGY.

Art. IV. *Observations on some Species of Zoophytes, Shells, &c. principally Fossil, by* Thomas Say, *of Philadelphia.*

(Continued from Vol. I. p. 387.)

Genus Catenipora, Lam.

Coral lapideous, composed of parallel tubes joined together in vertical laminæ; laminæ anastomosing into a network.

Species.

C. Escharoides, lamarck, millepora. *(Tubipora catenularia,)* American Acad. vol. 1. p. *Tubipora catenulata*, Gmel, &c. *(Cabinet Acad. Nat. Sciences; and Peale's Museum.)*

Fossil in different parts of the U. States, particularly at the falls of the Ohio river and in Ulster County, New-York. From this last locality, Mr. C. W. Peale obtained some fine specimens when digging for bones of the Mastodon.—Has not yet occurred in the alluvial deposit of New-Jersey.

Each tube is divided into numerous cells by transverse septæ, precisely as in the *Favosite.* Mr. Parkinson, in his Organic Remains 2, p. 21. remarks, that minute openings are observable in the sides of the tubes; these are not distinct in the specimen under examination, owing perhaps to its being entirely silecified, though an equivocal appearance justifies the belief of their having existed; and if so, the analogy is very strong with the *Favosites.* A species of *Turbinolia* is implanted in the specimen under examination.

Pentacrinus caput—Medusæ.

Of this very remarkable and rare animal, a specimen occurs in the collection of the Museum of South Carolina; it was brought from the Island of Gaudaloupe by Mr. L'Herminier. This is, I believe, the fourth recent specimen known, of this family of extinct animals: of the two other individuals one is in the French, and the others in British collections.

The well known fossil animal supposed to be of this family, so common near Huntsville and in some parts of Kentucky, and which has been figured and described by Parkinson, cannot be properly arranged under either of the genera. These vary in form and size. I have seen four very distinct varieties, but it is possible they may have belonged to different parts of the same pedicel.

Although this fossil is familiar to the observation of Naturalists, yet it does not appear that any particular name has been appropriated to it, or that it has been assigned to any definitive place in the systems.

From its peculiar appearance, persons who have not devoted their attention, to the affinities of natural objects, have regarded it as a petrified *nut* or *Althea bud*, and from the ambiguity of its characters, or the obliteration of its sculpture, naturalists have hesitated to indicate its family, or kindred generic group.

Parkinson is the first author who has figured and described this animal remain. He refers it to the genus *Encri-*

nus under the name of *Kentucky Asterial fossil*, but at the same time and subsequently, he expresses himself doubtfully, as to the propriety of that arrangement. His specimens were not so perfect as to exhibit the basal articulating radii, and the sutures and ossiculæ were perhaps obliterated, as they were unnoticed.

The examination of numerous specimens, in the collection of the Academy of Natural Sciences, collected by Mr. Samuel Hazard, near Huntsville, affords me an opportunity to corroborate the correctness of that arrangement.

But I am induced to believe, notwithstanding the imperfection of our knowledge of these animals, that the genus, as it now stands, needs the reforming hand of the systematist, that it is in reality a natural family, including several perfectly distinct genera of many species, the individuals of some of which, as their remains testify, were immensely multiplied in the ancient world.

Actuated by this conviction, I submit to the decision of Naturalists, the propriety of separating the asterial fossil, from the genus Encrinus, as the type of a distinct genus, under the following name and characters.

Genus Pentremite.

Body subglobular or oblong, elevated upon an articulated trunk; *pelvis* (Parkinson) pentagonal, more or less abruptly attenuated to the base; *ambulacra* (Lam.) five, incomplete, radiating from the summit and terminating each side at the angles of the pentagon, each with numerous transverse striæ, a longitudinal indented line, two sutures, and numerous transversed impressed lines, which alternate with a marginal series of oblique pores; *interstitial spaces* (included between the ambulacra) triangular, equal, with a longitudinal suture; *apex* perforated by five rounded foramina, and an angulated central one; *ossa innominata* (Park.) large, rhombic. TRUNK branched? cylindrical, articulated, elongated; *segments* perforated, articulating surfaces with alternately elevated and depressed radii.

A transient view of the superior portion of this reliquium, presents a considerable resemblance to the Echinii, by the apicial foramina, and by the radiating ambulacra which are somewhat similar to a pentapetalous flower. But an attentive examination of its characters, exhibits its inseparable connection with the family of Encrinites by the analogy of its mode of support, its rectilinear sutures, and the general form of its pelvis or basal portion.

To the base is generally attached, the single superior joint of the trunk or vertebral column; this joint is short, and is longitudinally divided by three sutures, which radiate from a central foramen; its inferior articulating surface is orbicular, with numerous marginal radii, and the centre exhibits the opening of the foramen; at its junction with the ossa innominata it is somewhat trilobate. The ossa innominata are of a rhomboidal form, sometimes pentagonal or subquadrate. The pelvis has the same general form with that of the *Encrinus liliiformis*, but the angles of the pentagon are much more acute, and those parts which Parkinson denominates *ribs*, *clavicles* and *scapulæ* are not distinct.

From the superior angle of each of the ossiculæ of the base, a *suture* ascends, bisecting each of the interstitial spaces, and is divaricated near the tip, so as to give to those triangular spaces, a rhombric termination. Each of the five outer foraminæ, (of which one is invariably much the largest) is the common aperture of two tubes which penetrate to the tips of the ambulacra, immediately beneath the sutures of those parts, and which are not visible but by dissection; the central foramen is stellate.

The peculiar adaptation of these various parts to each other, may have permitted their independent movement, in order that the animal might assume some form of expansion; but we are led to suppose that this motion could not have been very considerable, from the relative situation of the sutures. And I may further add, that, as we have no direct proof that this animal did possess the power of expanding, it may be, that the motion of its body was confined to the protrusion of tentacula through the foramina, and perhaps smaller ones through the pores of the Ambulacræ.

This question, however, must remain for the solution of future observers, who may have an opportunity to examine them in situ, and of comparing together their different fragments which may be discovered. All the specimens which I have seen, about sixty in number, are in a perfectly similar collapsed state.

The several different appearances exhibited by specimens of the *Pentremite* may be thus defined—

1st. *Pelvis* abrubtly attenuated, nearly horizontal—
Length from seven tenths to more than half an inch.
Kentucky Asterial fossil, Park. Org. Rem. vol. 2, pl. 13.
This is the most common.

2d. *Body* oblong; *pelvis* gradually attenuated; transverse elevated lines of the ambulacra, grooved—
Length from three fourths to one inch and one fourth.

3d. *Body* subglobular; *pelvis* hardly more attenuated than the superior portion—
Length about one inch—
Less common than the preceding ones.

In Peale's Museum a large specimen of the latter is preserved, of which the sutures, have each a parallel impressed line on each side; this specimen was brought from England by Mr. Reubens Peale, he was informed that it was found in the vicinity of Bath, but the fact is very equivocal.

A specimen of the second variety is in the collection of Mr. B. Say; it was presented to him several years ago under the name of *petrified althea bud*, and was dug up in a garden in the borough of Reading, Pennsylvania.

Mr. Z. Collins informed me that this fossil has been noticed and figured, by Dr. S. L. Mitchell, of New-York, as an *Echinus of the family* (genus) *Galerite*, and also as an *asterite*. See his geological observations in the New-York edition of Cuvier's theory as translated by Jameson p. 363, pl. 8. This figure indicates the above first variety.

Renilla Americana,

Is very common on the coast of Georgia and E. Florida, cast up by the waves.

Perna torta.

This large species of fossil Perna has been discovered at Upper Marlborough, in the state of Maryland, by Mr. J. Gilliams of this city. The hinge portion is very entire, but the anterior part, is more or less broken off, as is the case with those found in Europe and like them the substance of the shell is in a tolerable state of preservation, not having undergone much apparent change, excepting that the lamellary increments are readily separable and very friable, the epidermis also is wanting.

It is the same species of shell as that described and figured by Collini in his Journal p. 10, pl. 6. fig. 1. under the name of *Ostreum polyleptoginglimum;* and also anonymously, by Parkinson Organ. Rem. vol. 3, pl.

The teeth of one specimen, in the possession of the Academy of Natural Sciences, are obsolete.

Collini says, it is often perforated by *sea insects;* our specimens are also penetrated, but the cavities are formed by an ampullaceous *Pholas*, which in reality may be the same as those which that author alludes to, by the term sea insects; it may be thus named and described.

Pholas ovalis.

Tube equal, entire and rounded at base, and gradually attenuated towards the anterior termination. *Shell* subovate, dehiscent; *valves* with crowded, acute, elevated, transverse lines, somewhat decussate with longitudinal slightly indented ones, a more conspicuous, longitudinal, indented line before the middle, posterior basal margin smooth; within equal, the posterior basal margin distinguished by a slight undulation.

This is not, strictly speaking, a *Pholas*, inasmuch as it is included in a tube; but in other respects it corresponds very well with the species of that genus, as far as I can judge from incomplete specimens, not having seen the accessory valves. It will not agree with *Teredina* Lam. as its valves are concealed by the tube; by which character it is assimilated to *Fistulana*, but from this genus also, it is distinguishable, by the form of its valves, and most probably, by being destitute of the anterior, crustaceous, branchial appendages or valvules, though it is proper to observe that the anterior extremities of the tubes (which contain these parts in fistulana, teredo, &c.) are deficient in my specimens of *P. ovalis.*

In the somewhat compact earth which was included between two fragments of the valves of the abovementioned *Perna*, were a few interesting shells, some of which are perfectly firm and entire, others, although to all appearance similarly circumstanced, are extremely friable, and even fatiscent. Amongst these I recognized a *Crepidula*, which differs from any I have seen, but is too imperfect to be described. A portion of an obtusely rugose incrassated, *Serpula*. A *Pecten* which does not appear to have attained to its complete growth. A small laminated *Cytherea*, Lam. a *Fissurella* allied to *F. græca*, but immature. A *Turritella*, and fragments of a *Balanus* of considerable size, several specimens of a *Nucula* and of a *Calyptraca*. The two latter may be described as follows.

Nucula obliqua, valves obliquely subtriangular, obsoletely striate transversely, one or two of the striæ more conspicuous, numerous, hardly perceptible longitudinal striæ; anterior and posterior sides forming an acute angle; *umbo* obtuse; *apex* acute; *teeth* angulated, prominent, cavity at the apex of the hinge profound, rather long; basal margin denticulatocrenate.

Greatest length one fifth of an inch.—

Very much resembles *Arca nucleus* Lin. but is a smaller species, and proportionally narrower towards the apex, the hinge teeth are also more prominent and the cavity at the apex of the hinge is proportionally larger.

Calyptræa costata, oval, convex, with numerous slightly elevated, equal equidistant costæ, and crowded obtuse, concentric lines, which are regularly undulated by the costæ; *apex* mamillated inclining to one side; *inner valve* pateliform, dilated, attached by one side to the side of the shell, acutely angulated at the anterior junction, and rounded at the posterior junction, and rapidly tapering to an acute tip, which corresponds with the inner apex of the shell.

Length nearly one inch—

Seems to approach, in its characters to the genus *Infundibulum* of Montf. but from the fatiscent state of the specimens, this cannot be acurately determined. No definite spiral suture is perceptible.

Genus Baculites, Lam.

Shells straight, cylindrical, compressed, slightly conic, divided within into transverse septa, which are sinuous or ramose on their margins and pierced with a siphunculus; siphunculus at one extremity of the longest transverse diameter.

Species.

1. *B, ovata*, elongated; transverse septa subovate, sixlobed and a smaller one behind; *lobes of the superior faces* of the septa, three on each side, with a minute one between each, dentated at their edges, anterior lobe, (nearest the siphuncle) small not sinuous, second lobe with a single projection each side and sinus at tip, third lobe dilated, with a small sinus each side and more obtuse and profound one at tip, posterior lobe hardly larger than the lateral intermediate ones.

Greatest diameter of the transverse section one inch and one fifth, smaller diameter seven tenths; length of the segment about half an inch.

The specimen is in the collection of Mr. Reuben Haines of this city, it was found on the Neversink hills, in Monmouth County, New-Jersey, it is a cast of three very entire segments, no vestige of the shell remaining. The dimensions are taken from the largest segment.

In point of form this species approaches *B. vertebralis*, *Lam.* particularly in the curvature of the transverse section, but it is somewhat more obtuse behind; another difference consists in the form of the lobes, which, in that species, as represented by Mr. Desmarest, are less symmetrical, destitute of the lateral processes and of the profound terminal sinus; that species also is very diminutive.

2. *B, compressa*, elongated, much compressed; *transverse septa* oblong-oval narrowed to each end; *lobes* dilated, dentated on their edges, each with from three to five sinuses each side and a very profound one at tip.

This description is taken from two fragments in the collection of the Academy of Natural Sciences, which were brought from the Missouri, one by Messrs. Lewis and Clark and the other by Mr. Thomas Nuttall. As they exhibit the appearance of having been violently compressed by fortuitous circumstances, I have not been able to obtain correct proportional dimensions of the species. But notwithstanding this distortion of form, I have much confidence in placing it next in specific affinity to *B. Knorriana*, Desm. as it has without doubt been naturally a much compressed shell, with the lateral edges not very unlike those of that large and remarkable species; from which, however, it is sufficiently distinct by the much developed form of the lobes.

In these specimens a considerable portion of the shell remains exhibiting its beautiful iridescent colours.

Mr. Nuttall gave me the following account of this species. It occurs in the ancient alluvium of the Missouri, or clay formation, reposing adventitiously on the chalk stratum of this region, and imbedded in the indurated shistose beds, amidst other shells, and in the beds which overlie more or less intimately the Xylanthrax or Surturbrand; they are gradually and regularly acuminated through a length of twelve or eighteen inches, being from three to four inches broad at the base and diminishing to less than half an inch, but a perfect apex or base has not yet been discovered.—They are of frequent occurrence, washed out on the banks of the river, from White river of the Missouri to the Mandans, but at the same time, locally and not uniformly distributed.

Genus Ostrea.

O. convexa, Oval, inequivalve; *inferior valve* remarkably convex, with a longitudinal indented line on one side, slightly auriculated, or rather, angulated each side of the hinge, a longitudinal, transversely wrinkled depression, each side before the hinge; *ligament cavity* oval, placed beneath the apex; *superior valve* suborbicular, flat or somewhat concave, radicated from the apex to the periphery, annual increments strongly marked; *hinge* each side before with transverse rugæ.

Length of the convex valve nearly three inches, breadth two and an half—depth about two inches. Cabinet of the Acad. Nat. Sciences.

A perfect specimen was found by Mr. S. Wetherill near Burlington, N. J. I have since obtained a ferruginated one at Mulliger Hill in the same state. It is remarkable for the great convexity of one of its valves and by the angles each side of the hinge.—It closely approaches to the genus *Gryphæa*; the lower valve is even proportionably more convex than that of *Anomia gryphæa*, and is also furnished with the indented line or lateral lobe as in that shell, but the umbo is not prominent, the superior valve is as operculiform as that of the shell abovementioned, and indeed, with the exception of the less elevated umbo, it is almost as closely related to *Gryphæa* as the *G. dilatata* of Sowerby.

Genus Exogyra.

Shell inequivalve, inequilateral; *cicatrix* one, large, deeply impressed, subcentral; *inferior valve* convex, attached, umbo spiral, spire lateral, prominent, hinge with two parallel, transverse grooves; *superior valve* discoidal operculiform, umbo not prominent, revolving spirally within the margin, hinge with a single groove on the edge.

E. costata, *apex* lateral, with about two volutions; *inferior valve* convex, costate, transversely corrugated, costæ of the disk somewhat dichotomous, sometimes fornicated; *within*, a single profound cicatrix placed rather nearer to the inner side; *hinge* with two nearly parallel, profoundly excavated grooves, of which the inner one is shortest, and corrugated; *superior valve* flat, slightly concave, destitute of costæ, outer half exhibiting the increments, outer edge abruptly reflected from the inferior surface to the superior, but not elevated above it; *hinge* with a single groove on the edge; *cicatrix* profound.

Length four inches, breadth three and a half.—Cabinet of the Acad. of Nat. Sciences.—Peale's Museum.

This interesting shell is the largest and most perfect of its class, which has yet been found in the Ancient Alluvial deposit of New-Jersey. It is not uncommon. I have seen many specimens. They vary somewhat in the costæ, being sometimes almost antiquated, sometimes nearly smooth. The aged shells became extremely thick and ponderous.

It seems to differ from the genus *Gryphæa* by having been attached, and by the lateral situation of the spire; the hinge grooves also are parallel with the edge, so as to be transverse with respect to the shell, bearing some resemblance to those of some species of *Chama*.

Genus Terebratula.

T. plicata, suborbicular, convex, ten or twelve profound, longitudinal plicæ, the two middle ones of the siphunculated valve, slightly more elevated, and the corresponding ones of the opposite valve, slightly more depressed; two or three more conspicuous incremental lines are continued so as to cross the projecting face of the siphunculated hinge margin, which is but slightly prominent.

Cabinet of the Acad. Nat. Sciences.

This handsome species was found in the New-Jersey Alluvium by Mr. S. Wetherill of Burlington. The folds are somewhat similar to those of *Plicatula plicata*. It resembles the *T. crumena* of Sowerby, in the form of its folds, and in their extending to the beak, but the middle of the front is very slightly elevated, with but two folds, instead of three as in the *crumena*, the sides also have two or more folds, instead of four or more, and the beak is not very prominent.

Belemnites.

These are often found in the New-Jersey Alluvium, sometimes entirely changed into chrystalized blue iron earth, (*Hydrate of iron*, of Judge Cooper.)

Ammonite.

A species of this genus was found in the abovementioned locality by Mr. Wetherill. It approaches nearest to *A. elegans* of Sowerby, but I have not seen a specimen sufficiently entire to determine its species with exactness.

Dentalium.

A species has been found in New-Jersey, near Mulliger hill, by Mr. A. Jessup, which seems to approach nearest to *D. sulcatus*, but as it has only about sixteen equal costæ it is more than probably a new species.

Turritella.

A species of this genus was found by the same gentleman with the preceding, in plenty. It approaches very closely to the *T. conoidea* of Sowerby and is most probaly the same species.

I have seen several redintrigrate fossils from the New-Jersey Alluvium, amongst which I may mention a *Cucullaea*, *Lam.* which in general form resembles *C. Glabra*, length about one inch and three fourths, breadth rather more ; an *Arca*, about one inch wide ; a *Terebratula* which seems to approach nearest to *T. ornithocephala, Sowerby ;* a large species of *Terebratula* resembling the *F. ovoides* of the same author, excepting that it is very slightly truncated before. I found at Mulliger hill a *Natica* much changed by the ferruginous matter so abundant in that region ; length nine tenths of an inch ; and also a somewhat distorted impression of a *Mytillus*. Specimens of *Turbinolia*, Lam. often occur in different situations.

MEDICAL BOTANY.

On the Ergot of Rye, by Dr. William Tully, *of Middletown, Connecticut.*

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE, &c.

Dear Sir,

I SEND you the following Essay, for publication in your Journal, not so much from my own judgment, as at the suggestion of Professor Ives, to whom it was read a short time since.

As the regular and scientific employment of the *Clavus*, in medicine, originated exclusively with American Practitioners, and has so nearly superseded the use of the *Forceps* and *Vectis*, in obstetrical practice, that they are not now necessary in one case out of a hundred, in which they were formerly employed ; and as most of the information, which has been laid before the public, respecting the article in question, is in disjointed fragments, and dispersed through various distinct works, it was thought, that a digested summary of what appears to be well founded, with respect to one of the greatest medical discoveries of the age, could not but be acceptable to the public.

As this sketch is not entirely medical, it seemed more proper, for a work devoted to science in general, than to one exclusively confined to Physic; and as your Journal includes Materiā-medica within its plan, and is, in all probability, more extensively known in our own and foreign countries, than any other American periodical publication, I take the liberty of forwarding it to you.

Yours Sir, very respectfully, &c.

WILLIAM TULLY.

SCLEROTIUM-CLAVUS. *Decand.*

Clavus-Secalis-Cerealis, Clavus-Secalinus, Mater-Secalis, Secale-cornutum, Secale-corniculatum, Secale-luxurians. Horned-Rye, Spurred-Rye, Ergot of Rye, Mother of Rye.

Ord. nat. Fungi Lin.

Europe, United States.

This article is parasitic within the glumes of some of the *Gramina*, most commonly of *Secale-Cereale*, but frequently of *Triticum-sativum, Hordeum-vulgare*, and *Avena-Sativa*. It is more rarely found upon *Triticum-repens, Avena-elatior, Alopecurus-pratensis, Arundo-Cinnoides, Festuca-fluitans, Phalaris-Canariensis, Lolium-temulentum, Phleum-pratense, &c.*

There have been three distinct opinions, respecting the origin and nature of the *Clavus*.

First. It is affirmed to be a morbid change, or modification of the seed of the plant, upon which it is found. This has been supported by the assertion of Teissier, that he found seeds, one half of which were sound rye, and the other half *Clavus*; and by the assertion of others, that in Chemical composition, it approximates nearer to the seeds of the plants upon which it is found, than to any other vegetable substance.

As to the statement of Teissier, it is to be remarked, that, as no one but himself has ever witnessed such a fact, it is highly probable, that he may have been incorrect in his observations; but admitting that he was not, the phenomenon in question, is nothing more than sometimes happens, with respect to some unequivocal examples of *Fungi*, that grow among seeds; as for example, the smut upon an ear of *Zea-Mays*. The conclusion from analysis will be found to have but little more weight, when it is recollected, that the composition of the seeds of the different plants, upon which it is found, is considerably various, and especially, that its own proximate principles, differ from every thing hitherto obtained from the vegetable kingdom.

The second opinion is, that the *Clavus* is an excrescence produced by the sting, and deposition of the eggs of an insect.

As there is no analogy in any respect, between this article, and such excrescences as are demonstrably occasioned by insects, this opinion must have originated from the fact, that the *Clavus* is occasionally found to be eaten by minute worms, and that small *larvæ* of insects, have been detected in it, which on being preserved, afterwards hatched into moths, or butterflies. These occurrences are however too rare to establish the hypothesis, to which they seem to have given rise, and our inevitable conclusion must be, that they are only accidental.

The third, (and only opinion which appears to be well supported,) is that the *Clavus* is a parasitic *Fungus*, like the different sorts of blight, smut, &c.

The correctness of this appears to me, to be fully established, by the following considerations.

First. This article has, exactly, all the physical characters, such as colours, form, taste, smell, &c. and even the casualties incident to *Sclerotium*, a *genus* of *Fungi*. This genus consists of small solid fungous bodies, of a rounded, oval, or elongated form, their interior substance hard, occasionally almost as much so, as wood, sometimes a little fleshy, always white or inclining to white; the outer skin in an early stage, is smooth, in a more advanced one often a little wrinkled, usually black, sometimes of a dingy purple, seldom yellow, or white, in several species, covered by a peculiar kind of dust, or efflorescence, of the same colour as the surface.

Second. It has, like the several species of *Sclerotium*, an appointed place of growth. Some of these, as we are informed, are subterraneous, on the roots of mosses, or in the mass of tan, in bark-beds, in close damp places screened from the light, as under moss heaps, or upon the surface of the ground under the droppings of cattle, on the nerves of cabbages stored under ground, upon the leaves and branches of plants that are beginning to decay, on the fading foliage of trees, on the rind of living fruits, on the receptacle of compound flowers, on the interior of fistular twigs, on the living leaf growing from under the epidemis, and (if the *Clavus* be admitted to belong to the *genus*,) from within, or near to the *germen* in the *Gramina*, and developed in the place of that organ. All this diversity of situation is similar to that of many other *Fungi*.

Third. It does not affect the general health of the plant upon which it grows, which is more remarkably the fact, with respect to the *genus Sclerotium*, than of any other parasites, as all the species, except *S. Cyparissiæ*, are developed, only after the plant has done flowering, or when it tends to decay.

Fourth. The *Clavus*, like other parasitic *Fungi*, is strictly topical, as one or more seeds in the same ear, may be completely destroyed by it, and the rest remain perfectly in their natural condition.

Fifth. The progress of the growth, and the maturity of the *Clavus*, like other parasitic *Fungi*, has no correspondence with that of the plant, or any part of it, on which it is found.

Sixth. The *Clavus* is not peculiar to one plant, but is found on a considerable variety, that differ very widely from each other. This is true of other parasitic *Fungi*, and it completely overthrows the opinion, that it is merely a morbid change of the seed, as it would be incredible, nay indeed impossible, that individual seeds, so diverse as those of *Secale*, *Alopecurus*, *Arundo*, *Festuca*, *Phalaris*, *Lolium*, *Phleum*, *&c.* should be converted into the same article.

Seventh. Increased humidity favours the production of *Clavus*, as it is said to do, of all the species of *Sclerotium*; but neither *Clavus*, nor any *Sclerotium*, can be produced, by any degree of artificial humidity. In addition *Clavus*, and all the *Sclerotiums*, abound more in certain districts, than in others, though external circumstances are equally favourable for their production.

Eighth. The *Clavus*, like other *Fungi* of a soft substance when young, whose seeds are commonly developed in a position, that does not admit of complete and free expansion, has the curious property of moulding itself in some measure, to the surface of the obstacle which presents itself.

Ninth. The chemical composition of the *Clavus*, as far as the subject has been investigated, seems to correspond more nearly to that of the *Fungi*, than to any other class of vegetables.

Tenth. The *Clavus* is said to be so like *S. compactum* and *S. stercorarium*, that its analogy can hardly be denied, by any, who have seen them together.

Eleventh. The Abbe Fontana is said to have planted in his garden, a number of grains of wheat and rye, and upon the top of each to have placed several grains of *Clavus*. The result was a crop, in which both the wheat and rye, were infested with *Clavus*. This has been considered an evidence of the contagious nature of *Clavus;* but does it not rather prove propagation by seeds; for Decandolle informs us, that, contrary to the opinions of Tode and Persoon, *Sclerotium* should be ranked between *Elvella* and *Clavaria*, as belonging to that group which have external organs of reproduction, and not internal ones, as in Truffle, to which it has been approximated. Indeed the difference of *Sclerotium* and *Clavaria*, are said to be so slight, as to occasion difficulty in characterizing them.

The *Clavus*, as it commonly appears, is externally of a violet colour, and internally white. Its form is cylindrical, tapering at the two extremities, occasionally straight, but generally curved somewhat into the shape of a crescent, in most instances with a longitudinal groove both upon the convex and concave side, though sometimes destitute of it on one, or even both sides. Its dimensions are from four to twelve lines in length, and from two to three in diameter. Its flavour is, at first, imperceptible, but after some time, it is disagreeable, nauseous, and sub-acrid. If chewed for a considerable while, it produces a sense of fullness in the throat.

A grain of it cut transversely and viewed through a microscope, is said to present an assemblage of small and brilliant grains like starch. The external and coloured pellicle, seen under similar circumstances, appears as a mass of a violet colour, strewed with small whitish spots.

When a grain is inflamed, by contact with a lighted candle, it burns with a white flame, distilling some drops of an oily liquid, emitting a dense black smoke, and smelling like burnt bread.

Willdenow speaks of two varieties of Clavus, the first of which he denominates *simple*, and describes as of a pale violet upon the out side, and as whitish and mealy within, without any smell or taste. The second he calls *malignant*, and affirms, that it is externally dark violet, blue, or blackish; and internally of a bluish grey colour, a fetid smell and a sharp pungent taste.

He supposes the latter to be active upon the human system, and the former inert.

From the best chemical analysis it appears that this article contains

First. A pale or fawn yellow-colouring matter, soluble in alcohol, and tasting like fish-oil.

Second. A white oily matter, of a sweetish taste, which is very abundant.

Third. A violet colouring matter, of the same shade as orchil, but differing from it, by being insoluble in alcohol, and easily applicable, to aluminated wool, and silk.

Fourth. An acid, probably the Phosphoric.

Fifth. A vegeto-animal matter, very abundant, and prone to putrefaction, yielding much thick oil, and ammonia, by distillation.

Sixth. A small quantity of free ammonia, which can be obtained at the temperature of boiling water.

This article, when taken in substance into the stomach, in moderately large doses, occasions nausea; and even a scruple, or a drachm, has produced vomiting, but without quickening the peristaltic motion of the alimentary canal. Very large quantities have occasioned head-ache, and temporary febrile symptoms.

Its most prominent effect however, is its direct action upon the *uterus*, producing and increasing contractions, when there is a predisposition to action, in that organ, and restoring the catamenial secretion, when obstructed. It must therefore be ranked in the Materia-medica as a *Partus-accelerator*, and as an *Emmenagogue*.

The cases in which it is indicated as a *Partus-accelerator*, are—

First. In the early stages of pregnancy, when abortion has become inevitable, uterine contractions are feeble, and hœmorrhage considerable, so that it has become important to abridge the sufferings, and lessen the danger of the patient.

Second. In cases of alarming hœmorrhage, near the close of the period of utero-gestation, not occasioned by attachment of the *placenta* over the *os-uteri*, and not accompanied by efficient contractions.

Third. In puerperal convulsions, in which action is morbid, and misplaced, and speedy delivery becomes necessary.

Fourth. In lingering labour, connected either with the death of the child, or owing to a cessation of contraction, the *os-uteri* being sufficiently dilated, and the other soft parts properly relaxed. This is its most important use, as it is here capable, in all cases, of superseding the employment both of the *forceps* and *vectis*, instruments, which, previous to the discovery of the powers of the *Clavus*, were not unfrequently necessary, but could seldom be used without some injury, either to the mother, or child, and usually to both.

Fifth. In retention of the *placenta*, from deficency of contraction, it is in general, if not always, capable of superseding the introduction of the hand.

Sixth. In subjects liable to hœmorrhage after delivery, from laxity and deficiency of contraction, this effect may be entirely prevented by the exhibition of a suitable quantity of the *Clavus* fifteen or thirty minutes previous to the time, when the labour would otherwise have terminated spontaneously.

Seventh. It may even be employed with advantage after delivery, to restrain the hœmorrhage, and moderate the excessive lochial discharge, which results from laxity, and debility.

In too early a stage of labour, before the *os-uteri* is sufficiently dilated, and when there is much rigidity of the other soft parts, or when there is any malconformation, or a presentation that requires changing, the Clavus seldom produces any benefit, but in general, greatly increases the sufferings of the mother, retards her ultimate recovery, and most commonly causes the death of the child.

As a *Partus-accelerator*, the substance in powder, or better the infusion or decoction, in the quantity of ten grains, to an ounce of water, may be exhibited every ten minutes, till its effect is produced.

It sometimes, though very rarely, proves inoperative, but not oftener than twenty-five grains of jalap fail of purging, or eight grains of Tartrate of Antimony fail of vomiting.

Indeed, so certain is this article in its operation, that all ordinary cathartics and emetics, in their customary doses, much more frequently prove inert. Its effect is generally speedy, sometimes taking place, in as short a time as ten minutes, and seldom later than thirty. The uterine contractions produced by it, are commonly powerful, and incessant, and almost convulsive, and by an experienced practitioner, may always be distinguished from such as are spontaneous. In doses of two or three grains, combined with a little opium, it is said, that it may be so managed, as to produce the interrupted pains of regular labour. If given after a full dose of opium, it is liable to fail of producing any effect.

As an *Emmenagogue*, the *Clavus* is not equally efficacious, convenient, and unfailing. In reference to this effect, the substance in powder, the infusion, decoction, and tincture have all been recommended, but here likewise, infusion and decoction seem to claim the preference. The quantity of the *Clavus* necessary to be taken daily, in *Amenorrhœa*, varies from two drachms, to an ounce ; and this often requires to be continued for some weeks. In these cases, it commonly produces some unpleasant effects upon the stomach, and occasionally head-ache, increased heat of the body, and pain in the hypogastric region.

On the whole, I am inclined to think, it will not be likely to come into repute, for this purpose.

We are informed, that some instances of *hysteria* have very suddenly yielded to this article, but are ignorant of the circumstances of the cases, without a knowledge of which, no precept can be laid down.

As relates to the medical history of this article, it appears, both from printed authority and traditional information, that some general and indefinite knowledge of the medicinal properties of the *Clavus*, has been, from time immemorial, in the possession of a few old women, and empyrical practitioners, in England, some other parts of Europe, and even in the United States.

In France, as early as 1774, it seems to have been used with considerable judgment, by some female practitioners, and probably as early as 1747, by a regular Dutch *Accoucheur*. The subject however, was in all probability, managed with the customary mystery of the times, and when brought to light, at a subsequent period, it seems to have been viewed, as a remnant of the credulity of an ignorant, and superstitious age. As it was reserved however, for the illustrious Jenner to investigate and promulgate to the world, the important discovery of Vaccination, so it has fallen to the lot of our countryman Dr. Stearns, first to search into, and ascertain by experiment: to reduce to scientific form, and make public the powers of the Clavus, and at the same time, to prescribe the true restrictions, and limitations, which should always regulate its use;—a discovery, which, next to Vaccination, may be regarded as the greatest of the present age, in the science of Medicine.

With respect to the poisonous qualities of the *Clavus*, and its power of producing malignant and epidemic diseases, there seems to be no foundation, for such opinions. The quantity taken with bread, must of necessity be so small, it must be diffused in such a quantity of flour, and so changed by the panary fermentation, as to become completely inert. Besides, it must have been eaten, from time immemorial, as well since, as before the occurrence of the diseases, that have been attributed to it, whilst their appearance has been so rare, as to cause them to be looked upon as phenomena. In this country, the *Clavus* seems always to have been abundant, and till of late, there has been no suspicion of its imparting deleterious qualities to bread. Even here, the diseases which have been ascribed to it, have occurred as frequently, prevailed as extensively, and proved as mortal, in parts, in which nothing but Maize and Wheat are used for bread.

The fact that epidemic causes have never been satisfactorily investigated, has left an unbounded field for conjecture and hypothesis; and, unfortunately for the credit of the human understanding, the one in question, is not the most absurd.

Vide New-York Medical Repository, 1807.—*Thacher's Dispensatory.—New-England Journal passim.—Prescott's Dissertation.—Decandolle in Brande's Journal of Science and the Arts.—Vauquelin in Do.—Dyckman's Duncan's Dispensatory.*

MATHEMATICS.

Art. V. *Mathematical Problems, with Geometrical Constructions and Demonstrations, by* Professor Theodore Strong, *of Hamilton College.*

[For the figures, see the annexed Plate.]

Problem I.

THROUGH three given points which are not in the same straight line, to describe a circle.

Let A, B, C (*Fig.* 1. pl. i.) be the three given points which are not in the same straight line, it is required to describe a circle the circumference of which shall pass through these points.

Construction. Join AB, BC, and AC. Then ABC is a triangle. Describe a circle about this triangle. (Sim. Eucl. IV. 5.) Then will the circumference of this circle pass through the points A, B, C.—*Q. E. I.*

Problem II.

Let there be three straight lines, which are not all parallel to each other, and do not cut each other in the same point, given, it is required to describe a circle, such that it shall touch each of them.

Let AC, BC, BH, (*Fig.* 2.) be three given straight lines which are not all parallel to each other, and which do not cut each other in the same point, it is required to describe a circle such that it shall touch each of them.

Const. Let AC, BC, produced if necessary, meet in C; and also CB and BH in B. Bisect the angle ACB by the straight line CD, and also the angle CBH by the straight line BD. Let them meet in D. From the point D draw DG, at right angles to BC, DF at right angles to AC, and DE at right angles to BH. From D as a centre, with radius DF, describe the circle EFG, which shall be the circle required.

Demonstration. Because the angle FCD = angle GCD and the angle DF = angle DGC, and DC is common to both the triangles DFC, DGC, the straight line DF = straight line DG. In like manner it may be shewn that DG = DE. Therefore a circle described from D as centre with DF as radius will pass through the three points E, F, G. And it is manifest also that it touches the lines BH, AC, CB, in those points, since the radii DE, DG, DF are severally perpendicular to the lines BH, BC, CA.—*Q. E. I.*

Problem III.

Given two points and a straight line in position, the points not being on opposite sides of the line; it is required to describe a circle the circumference of which shall pass through the two given points, and touch the given line.

Case I. When one of the given points is in the given straight line.

Const. Let AB (*Fig.* 3.) be the given straight line, C the given point in AB, and D the other given point.—Join DC, and through C draw CE at right angles to AB. At the point D in the line DC, make the angle CDE = the angle DCE. Then the side DE = side CE. Therefore a circle described from E as a centre with radius DE, will pass through C, and D. And it will likewise touch the line AB, this line being perpendicular to the radius CE.

Case II. When the straight line joining the two given points is parallel to the given straight line.

Const. Let AB, (*Fig.* 4.) be the given straight line, and C, D, the two given points. Join CD; and bisect CD in F. From F draw FE, at right angles to CD. Let FE extended cut AB in E. Through C, D, E describe a circle, which shall be the circle required.

Demonst. For Join ED, and EC. Because the angles EFC, EFD are equal, and CF = FD and FE is common, the angle FCE = angle FDE. But the angle FCE = alternate angle CEA. Therefore CEA = CDE. Therefore AB touches the circle CDE in the point E. (Eucl. III. 22.)

Case III. When the straight line joining the two given points is oblique to the given line.

Const. Join CD (*Fig.* 5.) and let CD produced meet AB in B. Take BE = a mean proportional between BD and BC.

Through the points C, D, E, describe the circle CDE, which shall be the circle required.

Demons. For since BE = mean proportional between BD and BC, $BE^2 = BD.BC$. Now since the circle passes through the points C, D, E, and $BD.BC = BE^2$, the straight line BA touches the circle. (Euc. III. 37.) *Q. E. I.*

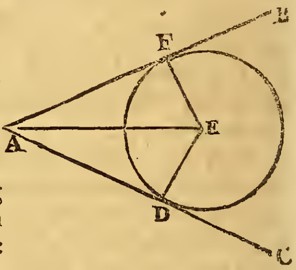
Cor. to Case I. If the point D should fall in EC produced, bisect the distance between the two points, and the proof is as before.

Problem IV.

Let two straight lines and a point which does not lie at the intersection of those lines, be given in position, it is required to describe a circle through the given point to touch the two given straight lines.

Case 1. When the given point lies in one of the given straight lines.

Construction. Let AB, AC be the given straight lines, and D the given point in one of the lines. Let the lines produced if necessary meet at A. Bisect the angle BAC by the straight line AE. Through D draw DE at right angles to AC, cutting the bisecting line in E. From E as centre with ED as radius describe a circle: which shall be the circle required. —For draw EF at right angles to AB.



Demons. The angle FAE = angle DAE and angle AFE = angle ADE and the side AE is common to both the triangles AFE, ADE. Therefore EF = ED. Therefore a circle described from E as centre with ED as radius, will pass through F. Now EF and ED are at right angles to AB and AC. Therefore the circle touches AB and AC in F and D. And (by Const.) it passes through D.—*Q. E. I.*

Case II. When the point is upon neither of the lines.

Const. Let AB, AC (*Fig.* 6.) be the given straight lines, and D the given point. Let AB, AC, produced if necessary, meet in A. Bisect the angle BAC by the straight line AE.

Through D draw DE at right angles to AE. Produce DE until EF = ED. Through the points D, F, describe a circle to touch the line AB.* And this shall be the circle required.

Demons. For suppose the circle EGH to touch the line AB in the point G. Through G draw GL at right angles to AB, and cutting the line AE in L. Because GL is drawn at right angles to the tangent AB, it passes through the centre, and since AE bisects the chord FD at right angles it likewise passes through the centre. L must therefore be the centre. From L draw LH perpendicular to AE. Now, since angle LAG = angle LAH, and the angle AGL = angle LHA, and AL is common to both triangles, LG = LH. The circle, therefore, passes through the point H. And since LH is at right angles to AC, the circle FGH touches the line AC. But (by Construction) it touches AB, and passes through the point D; FGH is therefore the circle required. Q. E. I.

Problem V.

It is required through two given points to describe a circle which shall touch a circle, given in position and magnitude.

Case I. When one of the given points is in the circumference of the given circle and the other either within or without the given circle.

Const. Let AB (*Fig.* 7.) be the given circle, B the point in the circumference, and C, (or C') the point without (or within) the given circle.—It is required to describe a circle such, that it shall pass through the points B, C (B, C') and touch the given circle. Join BC. Bisect BC in D. Take F, the centre of the circle AB. Join BF. Through D, draw DE at right angles to CB, meeting BF produced in E. Join CE, and with E as centre, and radius BE, describe the circle CB; then will CB be the circle required.

Demonstration. Because CD = DB, and the angle CDE = angle BDE, and DE is common to both the triangles CDE, BDE, CE = BE. Therefore the circle described from E as centre, with radius BE passes through C. It is also manifest

* Problem II.

that it touches the given circle. For draw LX touching the given circle in the point B. Then FB will be at right angles to LX. Now LX being at right angles to BE at the point B, which is in the circumference of the circle CBM, must touch this circle at that point. Therefore since both circles, AB, CBM, touch LX at the same point B, they must touch each other at that point.

In like manner by using the letters C·, D·, E·, &c. for C, D, E, &c., the demonstration will apply to the case, where the point is within the circle.

Case II. When the two points are either without or within the given circle at unequal distances from the centre.

Const. Let ABD (*Fig.* 8.) be the given circle, and C, E, the two points without the circle. It is required to describe a circle through those points which shall touch the given circle.—Take any point X within (or X· without) the given circle which is not in the same straight line with CE. And through the points C, E, X, describe a circle.—(Prob. I.) Let this circle cut the given circle in the points B, D. Join BD; and through the points C, E, draw CE meeting BD extended in F. Through F, draw FA, touching ABD in A. (E. III. 17.)

Demonst. Because the straight line FD cuts the circle ABD, and the straight line FA touches it, FD. FB $=$ FA². But FD. FB $=$ FC. FE. Therefore FC. FE $=$ FA². Let therefore, a circle be described through (Prob. I.) C, E, A. —Now this circle meeting FA in A, and FC. FE equaling FA²; FA must be a tangent to CAE, at the point A. Since, therefore, both the circles, ABD, CAE, touch the straight line FA at the point A, they must touch each other at that point.

In like manner, by using, C·, E·, &c. for C, E, &c. this demonstration is applicable to the case where the points are within the given circle.

Case III. When the two points are either within or without the given circle at equal distances from the centre.

Construction. Let AB (*Fig.* 9.) be the given circle, and C, D, the given points without (or C·, D·, within) the given circle at equal distances from the centre. Join CD, CH, HD. Bisect CD in E, and join EH. Let EH cut the circumference of the given circle in A. Through the points A, C, D, describe the circle ACD, which shall be the circle required. Through A draw FG perpendicular to EH.

Demons. Because CE = ED, HC = HD and HE is common to the triangles HED, HEC, the angles CEH, DEH are equal, being opposite equal sides. Therefore HE is perpendicular to DC. Now because CD is a chord in the circle CAD and is bisected at right angles by AE, AE passes through the centre of the circle. But FG is at right angles to EA, and EA passes through the centre of the circle CDA; therefore FG touches the circle CDA in the point A. But (by Const.) FG touches the circle AB in the point A. Therefore the circles CDA, AB, touch each other at the point A.—Q. E. I.

In like manner by using the letters C·, D·, &c. for C, D, &c. the above demonstration is applicable to the case where the points are within the circle at equal distances from the centre.

Scholium. As CD, GF are both at right angles to EH they are parallel to each other. Therefore the construction in Case II, failing, Case III is necessary.

Note I. When one of the points is within the circle and the other without, the problem becomes impossible; for then the circle which passes through those points will cut the given circle, which is against the Hypothesis.

Note II. All the cases of this problem (except the first) admit of two solutions; as is manifest from the above construction.

Problem VI.

It is required to describe a circle to touch two given straight lines and a given circle.

Case I. When the two given straight lines are parallel and the given circle lies between them, or cuts one or both of them.

Const. Let AB, CD (*Fig.* 10.) be the two given straight lines, and MI the given circle. Draw EF parallel to AB and distant from it, by a line = radius of the given circle. Draw also GH parallel to CD and at a like distance from CD. It is here to be noted that if EF fall between the given lines GH must likewise. Through Q the centre of the given circle describe the circle QNS touching EF, GH in N, S, respectively.—Join ON. Let ON cut AB in L. Then with O as centre and OL as radius, describe a circle XLP; which shall be the circle required.

Demons. For ON by the nature of the tangent is perpendicular to EF, and therefore to AB, which is parallel to EF. Now since XPL passes through L, and ALO is a right angle, XPL must touch AB in the point L. In like manner it may be proved to touch CD in P. But it likewise touches the given circle. For, join QO the centres of the two circles. Then OQ and ON being radii of the circle QNS are equal. Suppose the line QO to meet the given circle in X. Then (by Const.) QX = NL. Therefore OL = OX. Hence the circle LP passes through X. And if at the point X a perpendicular were erected, it would be a tangent to both circles at the same point X. The circles therefore touch each other at the point X. Wherefore XLP is the circle required.

Case II. When the two given straight lines intersect each other, and the circle is given in any position.

Construction. Let AB, CD (*Fig.* 11.) be the given straight lines and SN the given circle. It is required to describe a circle to touch AB, CD, and the given circle. Draw EO, OG, parallel to the two given lines and respectively distant from them by a line = radius of the given circle.—Let N be the centre of the given circle. Through N describe a circle NZ touching the lines EO, OG in the points F, F; of which circle let M be the centre. Join MF. Let MF cut AB in X. Then from M as centre with radius MX, describe a circle. And this shall be the circle required.—Join MN intersecting the circle SV in S.

Demonst. For NM, MF being radii of the same circle are equal. But NS = XF (by Const.) therefore SM = MX. Therefore the circle MW passes through the point S. Now MXF being perpendicular to EO, and EO being parallel to AB, it is likewise perpendicular to AB. Therefore AB is a tangent to the circle SXW. In like manner we may prove that CD touches SXW. Now, if from the point S a perpendicular be drawn to NM, it will be a tangent to both circles at the same point. Therefore the circles SXW, SV touch each other in S, whence SXW is the circle required.

By using NM+NS for MN—SN and MX+XF for MX—XF, the above demonstration is applicable where the required circle is to circumscribe the given circle. See Fig. 12.

Note. In case I. where the given lines are parallel, if the given circle and one of the given lines be on opposite sides of the other line, then the Problem becomes impossible.

Problem VII.

To draw a straight line touching two circles given in magnitude and position.

Case I. When the touching line does not pass between their centres.

Const. Let AF, BC (*Fig.* 13.) be the two given circles. Join their centres. Take CE = AB—BD, if AC > BD, and with CE radius and C (the centre of the given circle AF) centre, describe the circle EX. From D the centre of the other circle, draw DE touching the circle EX in E. Join CE, and produce CE until it meet the circle AF in the point A. At the point A draw the tangent AB and produce it to the circle BG. Then shall the line AB likewise touch the circle BG.

Demonstration. For, ED being a tangent to the circle EX, the line CE drawn from the centre to the point of contact will be at right angles to ED.—For the same reason EC produced is at right angles to AB. Therefore ED, AB are parallel. BD, therefore, being drawn from the centre D perpendicular to AB; ABDE will be a parallelogram, and EA, BD will be equal. But EA = radius of the circle BG. Therefore BD equaling radius of circle BG, the point B falls in the circumference of BG. And AB is at right angles to BH the radius of the circle BC in B. AB must therefore be a tangent to the circle BG in the point B. But AB is likewise a tangent to the circle AF in A, (by Const.) therefore AB is the tangent required.

Case II. When the touching line passes between the centres of the two given circles.

Const. Let the two circles (*Fig.* 14.) be AB, DE.—From O the centre of the circle DE, draw OF = radius circle AB + radius circle DE, and with OF as radius describe the circle GF. From C the centre of the circle AB draw CF touching FG in some point as F. Let the line joining

O, F cut the circle DE in D. From D draw DA parallel to FC. From C draw CA parallel to OF and let it cut DA produced in A. Then will DA be the tangent required.

Demonstration. For because CF touches the circle FG and from O the centre of FG, OF is drawn to the point of contact, the angle OFC is a right angle. But DA is parallel to FC and is therefore perpendicular to OF. Hence it touches DE. And AC being parallel to DF is at right angles to DA.

Moreover the figure ACFD is a parallelogram, and therefore AC = DF. But DF = radius of the circle AB.—Therefore A is in the circumference of AB. Now, the angle DAC has been proved a right angle. Wherefore DA touches the circle AB in the point A. But it likewise touches the circle ED. AD is therefore the tangent required.—Q. E. I.

Cor. to Case I. When the circles become equal, that is, when BD = AE, EC disappears. And BA is manifestly parallel to DC the line joining the centre of the two circles.

Cor. to Case II. When the circles become equal, that is, when OD = AC, OF = 2OD, therefore OC = 2OX, X being in the middle of the line OC.

Note. That this problem is impossible in both Cases, when one circle lies wholly within the other; in Case II, when one circle cuts the other.

Problem VIII.

It is required to find a point, from which any straight lines being drawn, cutting two circles given in magnitude and position shall cut off similar segments.

Case I. When the point does not fall between the two circles.

Const.* Let BD and PE (*Fig.* 15.) be the two circles. Draw BPA touching the circles in B and P (Prob. VII. Case I.) and produce this tangent, to meet FG (which joins the centres of the given circles) in some point as A. From

* Both the cases of this Problem admit of a very simple construction, which is independent of the 7th. A line joining the extremities of any two radii drawn parallel to each other, will intersect the line joining the centres (produced, in Case I.) in the point required.—Edit.

A draw any line AC, cutting the circles in C, H, N, O. The segments CBH, NPO are similar, and likewise the remaining segments CDH, NEO.

Demonst. For draw FB, GP to the points of contact of the tangent, and they will be perpendicular to it and consequently parallel to each other; draw also FC, FH, GN, GO. And suppose the line AC cuts BF, PG in Q, R. Now BF, PG being parallel, the triangles ABF, APG, as also the triangles AQF, ARG are similar. Whence—AQ : AK : : QF : RG, and AQ : AK : : QB : PR. Therefore QF : RG : : QB : PR; alternately QF : BQ : : RG : PR; by Comp. FB : QF : : PG : RG, that is, FH : QF : : GO : GR; (substituting for FB and PG their equals FH and GO.) Now the angles FHQ, GOR are each of them less than a right angle (standing on arcs less than a semicircle) wherefore (Eucl. VI. 7) the angles FQH and GRO being equal, the triangles FQH, GRO are similar, and the angles QFH, RGO are equal. In like manner it may be shown that the angles CFQ, RGN are equal. Whence the angle CFH = angle NGO. Therefore their halves CDH, NEO will likewise be equal. Therefore the segments CDH, NEO are similar, and likewise the segments CBH, NPO. (Euc. Def. B. 3.) Wherefore A is the point required.

Case II. When the point falls within the two circles.

Fig. 16. Const. Let AFN, HBK, be the two given circles. Draw (Prob. 7. C. 2.) the tangent BA cutting the line DE (which join the centres of the given circles) in C. Then will C be the point required.

Demonst. For through C, draw any line FCH, cutting the circles in F, G, H, I. Join EA, DB, which being perpendicular to AB, are parallel to each other. The angles LCE, DCM being vertical are equal. For the same reason ACL = angle MCB. Therefore the triangles ACL, MCB, as also the triangles LCE, DCM are similar. Therefore AL : MB : : LC : CM and LE : MD : : LC : MC, whence by equality, AL : MB : : LE : MD; alternately, AL : MB : : LE : MD; by compos. EA or EG : LE : : DB or DI : DM. Now the angles LGE, DIM are each of them less than a right angle; therefore (Euc. VI. 7.) the triangles LEG, DIM are similar, and the angle LEG = angle IDM. In like manner it may be shown that the angle FEL = angle MDH. Therefore the whole angle IDH = whole angle

FEG. Wherefore their halves FNG, HKI are equal. Consequently FNG, IKH are similar, and likewise the segments FAG, IBH. Therefore a point C is found as required.—*Q. E. I.*

Cor. I. By a similar construction, similar segments may be cut from spheres given in position and magnitude by a plane, as is manifest from the solution of this Problem.

Cor. II. When in Case I. the circles approach to equality, the point A becomes infinitely distant, and the line AC becomes parallel to AI, which passes through the centres of the circles.

Cor. III. When in Case II. the circles become equal, the point C (as in Case II. Prob. VII.) is equidistant from the centres of the circles.

Cor. IV. In Case I. the points C, I, M, O, are in the circumference of a circle. For $\angle$FCI = $\angle$GNL and $\angle$GNR = $\angle$FCH, therefore the whole angle ICH = whole angle LNO. But $\angle$LNO + $\angle$OML = two right angles, therefore $\angle$ICH + $\angle$OML = two right angles. Therefore the remaining angles CIM, COM = two right angles. Therefore the points C, I, M, O, are in the circumference of a circle.—In like manner H, K, L, N are in the circumference of a circle. Therefore the rectangle AM. AI = AC. AO, and also AK. AL = AH. AN.

Cor. V. Because (in Case II.) the segment yFAG is similar to the segment IBHx, the angle IHx = GFy and the angles at C being vertical are equal; therefore the triangles CyF, CHx are similar. But the triangle CrI is similar to the triangle CHx. For the angles Irx + IHx = two right angles; and Irx + Irc = two right angles: taking from both, the common angle Irx, there remains CrI = CHx, and the angle at C being common to the two triangles they are similar. Hence CFy and CHx being similar and likewise CHx and CrI, CFy is similar to CrI. Therefore CI : Cr : : Cy : CF. Therefore CI. CF = Cr. Cy. Therefore the points I, r, F, y are in the circumference of a circle. In like manner it may be shewn that the points G, z, H, x are in the circumference of a circle.

(To be continued.)

HARMONICS.

* *On different modes of expressing the magnitudes and relations of Musical Intervals; with some remarks, in commendation of* Professor FISHER'S *Proportionally-tempered Douzeave, calculated in page* 195. Vol. I.—*communicated to the Editor by* Mr. JOHN FAREY, Senr. *Mineral Surveyor of* LONDON.

TO PROFESSOR SILLIMAN.

Sir,

HAVING perused the two first numbers of your *American Journal of Science*, I have been gratified by observing the distinguished rank which two different subjects hold therein; one of which has, through a long period, been to me a favourite source of amusement, while relaxing from my professional studies and practice, under the other of these branches of knowledge.

The Essay on *Musical Temperament* by Professor Fisher, with which your work commences, has been to me, a rich treat, for which I beg to tender that Gentleman my best thanks, and to declare, that I have before met with nothing like it in point of utility, in an attentive perusal of nearly every thing which has been printed in the English language, on the subject of Musical Temperament, and as to the *correct and practically useful views*, which are therein taken of the subject. It is with the hope of drawing a more

* *Remark.*—The following communication was received soon after the fourth and last number of this work was published: and it is regretted that no earlier opportunity has occurred, of giving it publicity. We give it entire in the present Number, that we may present in one view the opinion of Mr. Farey (one of the few competent judges) respecting Prof. Fisher's original speculations on this curious subject.

extended attention to what Professor Fisher has done, that I am principally induced to make the present communication; relying with full confidence, on the candour of Professor F. and others of your Readers, who may interest themselves in this curious subject, for excusing the freedom of the remarks I may make.

The practitioners of Music, both Professional and Amateur, almost universally, as also a great majority of the Teachers and Composers of Music, and even many of the Writers of "Treatises" (as they are here technically called) on the theory and practice of Composition and on Tuning, are well known to have been so very generally unacquainted with, or so inattentive to, any of the correct methods of defining, measuring and calculating the musical Intervals which occupied their attention, as to have in no ordinary degree excited the surprise of every one, who has compared these many able and ingenious Individuals, with the cultivators of nearly every other of the branches of Science and polite or useful Arts amongst us; into which happily correct notions and nomenclatures, and accurate *notations and modes of calculating*, every thing which comes within the definition of *quantity*, is either introduced and established, or is now in rapid progress towards this desirable end.

I was first led to make the above remarks, on the occasion of the establishment of the *Choral Fund* in this Metropolis, almost thirty years ago, and while I acted as its first Secretary, Librarian, &c. which brought me into acquaintance with numbers of the most eminent of the Characters alluded to; with many of whom, and the successors, alas! of too many of them, I have continued to cultivate this acquaintance, and as often as opportunities offered, have conversed with them on the subjects, to which I am now alluding: from all which, and the concurrent experience of all such of my Acquaintances, as unite a knowledge of Mathematics with that of the principles of Music, I have long been convinced, that the chief cause of the evil I am deploring, has arisen from the very unnatural manner, except to Mathematical adepts, in which *the ratios* of the lengths of *strings* define musical Intervals, with a view to comparing or calculating the magnitude of such Intervals: and it is the same, with regard to the number of *vibrations* or pulses, made in a given time, by the sonorous body, or excited in the air, for yielding different sounds; because it is *the ratios*, only, of these, that can be applied to the comparing or calculating of musical Intervals; involving, in all such cases, the unnatural and laborious substitution of *the multiplication of vulgar Fractions*, in the place of simple *addition*, and the substitution of *division of vulgar Fractions*, in the place of simple *subtraction*, of the Intervals under consideration: a consequence of which is, that *the smaller the Intervals* are, *the larger* do *the numbers* expressing them become, and the more difficult of conception and the more laborious, does the expressing or calculating of them become; and hence it can excite no wonder, that nearly all who may not have been induced to cultivate some acquaintance with Mathematics, for its own sake, have, as Musicians or Tuners, been so bewildered and disgusted, at the very outset of their attempts to understand this important and fundamental part of their subject, as to have given up the pursuit; being content to remain ignorant of that which was presented to them by the professed Writers on the subject, in so unnatural and forbidding a form.

It is observable, that *the small Intervals* above alluded to, as occasioning the chief stumbling block, are not merely such as curiosity only, and not utility, requires to be brought into review, but they concern each and *every one of the Intervals* which are considered, when we attempt to speak of *the Temperaments of the Musical Scale:* and hence, it has been next to impossible, that the mere Arithmetician, who proceeded to add and subtract Intervals according to the unnatural plan above mentioned,* could complete the calculation, or understand the true nature, of any one of the various modes in which the musical Scale *may be* attempered, or even comprehend *the untempered Scale* itself, in so much of its generality as the same is now actually exhibited, on the Euharmonic organs of Mr. Liston, and *always has*, although almost unperceived, *been practiced*, by the correct Singer, the Violinist, and a few other Practitioners

* That most indefatigable Calculator, the late Mr. *Marmaduke Overend*, proceeded in this way, and brought his labours to no useful conclusions, except in the discovery of three *smaller Intervals* than any that had before been mentioned by Authors, and of some few other new Intervals, which are somewhat larger, as I have fully explained in Mr. Tilloch's Philosophical Magazine, in Vol. 28. p. 140.

on Instruments which are *perfect*, as to their capability of yielding any degree of sound whatever, which either theory or the judgment of the ear might require.

Since the period of the sublime invention of Logarithms, and their general diffusion in Tables of the present form, such have opened new and great facilities to the mathematical calculators, on the subject of the musical Scale and its Temperaments; but it has been almost in vain, that appeals have been made to the mere Musician or Tuner, on the utility and the easy application of these *measures of Ratios*, because the original difficulty has as often recurred, viz. the want of apparent and *natural connection*, between ratios and musical Intervals. I have on various occasions* attempted to remove this difficulty, by shewing, that the reciprocal common Logarithm of any Interval, correctly expresses *the decimal relation* which that Interval bears, to the concord called the major Twentyfourth, or XXIV (or 3VIII + III) whose Ratio is $\frac{1}{10}$, and its reciprocal logarithm is 1·0000000; but the difficulties with this class of Persons have in no degree been removed, by endeavouring to explain to them, that the reciprocal of a logarithm answers to the substitution of *division* in the place of *multiplication;* (or *vice versa;*) and in the present case, that the change of $\bar{9}$ or −9, as the tabular index of the common logarithm of the fraction $\frac{1}{10}$, to 1·, answers completely to the tuning or considering of a XXIVth downwards, instead of upwards, between its terminating sounds.

When all the decimal places of figures beyond the fifth, had been arbitrarily rejected, and the recip. log. so abridged, multiplied by 100000 (as was done first, I believe, by Dr. Robison) in order to obtain measures for the various Intervals of the scale, and its Temperaments, I have not found these further deviations from any visible natural connection, between the arbitrary numbers so obtained, and the musical Intervals they are made to represent, to have the least tendency towards gaining the attention and assent of the Musicians and Tuners whom I have conversed with; but the reverse of it, in more than one instance; in one of which cases it has been urged to me, thus: " If the logarithmic

* See the " Edinburgh Encyclopœdia," edited by Dr. Brewster, vol. VII. p. 31, vol. XI. p. 598, and in several other parts of that truly valuable Work.

measures of ratios admit of being thus modelled at will, how are we any longer to place confidence in those Writings, which speak always of the Concords, and the other Intervals of the scale derived from them, as being *rigidly measured* by ratios, in *small whole numbers*, involving no prime larger than 5?" To this, it may not be unseasonable for me now to add, that in making the above mentioned rejection of the sixth and following places of recip. logs., although so great an error as $\frac{3}{10}$ths of the fifth unit figure is not necessarily committed, in any of the Concords within the Octave, (or in the major or minor Tones, or the major Semitone, which are usually termed their elements,) yet in the major *Comma*, the error is unavoidably $\frac{5}{10}$ths, in the expression for the Interval, which so often happens to be the unit of the Temperaments: and although it may be said, that even this is but the $\frac{1}{1080}$th part of a comma, yet this is sufficient to shew the want of a natural foundation for this mode of representing Intervals; however useful to the Mathematician, as approximations, the same may with truth be contended for, as has been done by Professor Fisher, in your 17th page.

Notwithstanding it is found thus difficult *to define*, or to assign intelligible *measures to musical Intervals*, owing to the remoteness of the analogy by which such are connected with the ratios of Numbers, the most evident analogies connect many of these Intervals *with each other*, and shew them to be *quantities capable of addition and subtraction:* thus, no one with the least ear for music, will dissent from the truth and conclusiveness of the experiment, performed on an Organ or Piano-forte in his presence, of *tuning*, perfect (and without any beatings) 1st, a major Fifth upwards from a given note, (as C) to G, and then a minor Fourth upon this, or Gc, that then the compound interval Cc, is a true Octave; 2dly, if the IIId CE, and on it the 6th Ec, be tuned, he will agree, that the very same Note c has been arrived at, as before; and 3dly, when the 3d CE♭, and then the VIth E♭ c are tuned, he will still agree, that the same note c is again arrived at; proving clearly, that either of these three pairs of Intervals, make up, together, the same *sum* of Intervals, viz. an Octave.

So in like manner, if the perfect Octave Cc be first tuned upwards, and then either of the above six concords tuned downwards from c, another one of these concords, which is called its complement, will in every case result or remain (true, and without any Beats, as all experiments prove) as the *difference*, between the lower Octave note C and the lowest note of such subtracted concord.

It has been, therefore, with some propriety, that the majority of the writers of Treatises, have adopted, and adhered to the principle, of *defining Intervals, as the sums or differences of other Intervals*, or of some of their multiples: and the very frequent use of the major Tone T (having the ratio $\frac{8}{9}$), of the minor Tone t ($\frac{9}{10}$), and of the major Semitone S ($\frac{15}{16}$), as degrees or leaps in the Scale of melody, have led these Writers almost unanimously to adopt those three Intervals, as *the terms of their Notation* of Intervals, in general: in which manner, for example, the above seven Concords, beginning with the smallest, are expressed as follows, viz. T+S, T+t, T+t+S, 2 T+t+S, 2 T+t+2 S, 2 T+2 t +S, and 3 T+ 2 t + 2 S; which answer to the Literals, E♭, E, F, G, A♭, A and c, respectively. If now we omit A♭, and supply the six remaining discords, and also the lower octave note, for completing, in this notation, the Douzeave which Mr. Liston calls the *Original Scale*, (p. 28 of his "Essay on perfect Intonation,") they are as follows, viz. C=o, C♯=T−S, D=T, F♯=2 T+t, G♯=2 T+ 2 t, B♭ =2 T+2 t+2 S, and B=3 T+2 t+S.

Those who may proceed no further than to the consideration of the scale of 12 notes, which is defined above, without proceeding to supply the other intermediate notes, which become necessary in extending the modulation, (as Mr. Liston has done,) may remain in a great degree ignorant of the great defect of this particular mode of Notation: arising, not from any defect in *its principle*, as has been observed above, but merely from *the largeness of its terms*, T, t and S; which occasion *negative signs* so frequently to occur, and connecting such *varied multiples* of these terms, as almost certainly to bewilder and disgust most of those who may attempt to follow Mr. Liston, through the large folding Tables inserted in his Essay. I have conversed with more than a score of Musicians, who had previously perused Mr. L.'s Essay, but not one of whom had got over the stumbling-block last mentioned.—One of these Gentlemen, having more perseverance than others, observed to me nearly as follows :— If, said he, I want to know whether, in Mr. Liston's Scale, c♭ is a higher or a lower note than his B♯; I find these Notes defined in his Tables, by 3 T + 3 t, and 2 T + 2 t + 3 S, respectively : but my not being able to carry in my head the recollection of the exact comparative magnitudes of T, t and S (whose relations in decimals of either of them, I understand to be interminate, as to places of figures, such never ending, or circulating) I am unable to perceive which of these quantities is the largest : if, continued he, I suppose the first to be the largest, and deduct the last from it, as algebraists do, I obtain T + t − 3 S : but here again, from not being able readily to perceve whether T + t is larger than 3 S, I am left in doubt, until after a calculation of some considerable labour, for deciding whether I have made a wrong or a right supposition. Again, said he, if I want to know whether Mr. L.'s B′♯, is higher or lower than his ċ ; his expressions for them, respectively, are, 4 T + 2 t, and 2 T + 3 t + 2 S ; but such are not fitted for conveying at sight the information wanted : —if I take their difference, as before, I find it to be 2 T − t − 2 S, which leaves me under similar difficulties, as in the first case.

Long before Mr. Liston published his Essay, or I had heard his name mentioned by any one, I had provided a remedy for the inconvenience above stated, in the Notation to which Professor Fisher has referred, in your 18th page : founded on *the same principle* as above, but using three *very small Intervals*, for the terms of my Notation, derived from the Manuscripts of Mr. Overend, already mentioned, and which had been marked by him Σ, f and m ; but which Intervals, or any others, he had not adopted or used as a Notation ; they merely stood amongst a multitude of his isolated results.

The largest of my Terms Σ (or the *Schisma*), is the very same small Interval 2 T − t − 2 S, which is mentioned above ; it occurs also, between ten others of the adjacent notes in Mr. Liston's Scale of 59 notes ; and it is *the smallest* Interval which can ever occur, in the calculation of even far more extended Euharmonic or untempered Scales, than those of Mr. Liston's Essay, as I have since fully shewn, in the Phil. Mag. vol. 39, p. 419, and vol. 49, p. 362, &c. : its ratio is $2^{15} \div 3^{8} \times 5$; my second Term f (or the lesser

Fraction) is of the diatonic value—9 T+7 t+5 S, and its ratio is $3^{37} \div 2^{54} \times 5^2$; and my third Term m (or the most *Minute*) is $= -21$ T+10 t+22 S, and its ratio is $3^{64} \times 5^{12} \div 2^{161}$.

Complicated and appalling as these diatonic expressions and ratios may appear at first sight, to many, the Intervals Σ, f and m are, nevertheless, strictly *founded in Nature*, and will as truly and as correctly represent musical Intervals, in every possible case, as the Ratios composed of the prime integers 2, 3 and 5, or any notation by Intervals, can do: and with the important advantage, in no other way so well attainable, of *an increasing series*, throughout, in each of its terms, as the Intervals increase in magnitude, which are thereby expressed; and yet, *without negative signs*, in any case that can be of the least use. They have other material advantages over any other notation by means of Intervals that has been proposed: yet these I shall not here enlarge on, but proceed briefly to mention, as follows:

The Octave, or $\frac{1}{2}$, is in this notation, of the value 612Σ+12f+53m, the major Twelfth (or VIII+V) or $\frac{1}{3}$, is= 970Σ+19f+84m, and the major Seventeenth (or 2VIII+III) or $\frac{1}{5}$, is =1421Σ+28f+123m: which three expressions, in terms of Σ, f and m, answer to the three prime integers 2, 3 and 5, and will therefore serve for reducing any diatonic Interval whose Ratio is given, into this notation, by merely *adding* either of these expressions, as often as its corresponding integer is multiplied into the *denominator* of the Fraction (or largest number of the Ratio) and *subtracting* such expressions, as often as such integers, respectively, are found multiplied in the *numerator* of the fraction. The following examples will, I hope, make the application of this rule easy to any one.

1st. If the ratio given, be that of the major Fifth, or $\frac{2}{3}$, we have only to take 970Σ+19f+84m, and deduct from it 612Σ+12f+53m, and the remainder, or 358Σ+7f+31m, is the notation of V, as required. 2nd. If the major Third or $\frac{2 \times 2}{5}$ be given, we must take 1421Σ+28f+123m, and from it deduct the double of the first expression, or 1224Σ+24f+106m, which leaves 197Σ+4f+17m, for the notation of III. 3rd. If the major Comma be given, its ratio is $\frac{80}{81}$, or $2^4 \times 5 \div 3^4$, and we must first take 4 times the second expression, or 3880Σ+76f+336m; and next, 4 times the first expression, or 2448Σ+48f+212m, and add it to the third expression, making 3869Σ+76f+335m, and then deduct this last, from the multiple first found in this case, and the remainder is 11Σ+m, the notation of c. Further examples may appear unnecessary here; yet it will be proper to add, that if the calculations by this rule are gone through, which are indicated above, by the ratios answering to Σ, to f, and to m, respectively, *they* only, will be found to result, respectively; or, the truth of the whole may be demonstrated in various other ways, as is shewn in the "Edinburgh Encyclopœdia," vol. IX. p. 275.

TABLE I.

Lite-rals.	Ratios.	New Notation. Σ	+f	+m	Numerals.	recip. Logar.
C	1÷2	612	12	53	VIII, or Octave.	·3010299,96
B	8÷15	555	11	48	VII	·2730012,72
B♭	9÷16	508	10	44	7	·2498774,73
A	3÷5	451	9	39	VI	·2218487,50
G♯	16÷25	394	8	34	Ext. ♯V	·1938200,26
G	2÷3	358	7	31	V	·1760912,59
F♯	32÷45	301	6	26	IV	·1480625,35
F	3÷4	254	5	22	4	·1249387,37
E	4÷5	197	4	17	III	·0969100,13
E♭	5÷6	161	3	14	3	·0791812,46
D	8÷9	104	2	9	II (or T)	·0511525,22
C♯	128÷135	47	1	4	I	·0231237,99
C	1÷1	0	0	0	1	·0000000,00
A♭	5÷8	415	8	36	6	·2041199,83
D\	9÷10	93	2	8	II (or t)	·0457574,91
D♭	15÷16	57	1	5	2 (or S)	·0280287,24
C′	80÷81	11	0	1	c	·0053950,32
	32768÷32805	1	0	0	Σ	·0004901,07
	450283905 &c. / 450359962 &c.	0	1	0	f	·0000733,50
	292297733 &c. / 292300327 &c.	0	0	1	m	·0000038,53
1	2	3			4	5

In the work last quoted, vol. XIII, p. 41, the 59 notes of Mr. Liston's Scale will be found expressed in the notation that has now been described; from which I have extracted, and placed in Table I. the 12 notes of his *original Scale* already mentioned herein.

The seven last lines of the above Table have been added, in order to include the concords of minor *Sixth*, the minor *Tone*, the major *Semitone* and the *Comma*; and the *Schisma*, the lesser *Fraction*, and the most *Minute*. This Table can hardly need further explanation: I will therefore proceed to some further remarks.

The expressions in col. 3 of the above Table, *accurately* express the values of the Intervals in cols. 4 and 2: and such is the peculiar and natural connection, between the rates of increase upwards in the Table, for each of the terms Σ, f and m, that whatever result or truth appears conjointly from the three terms, after any process of adding or subtracting Intervals in any manner, has been performed, the same result or truth appears also, *from each of its terms separately*: there being here, no carrying or borrowing (in whole numbers, at least) from one column to another, as in common Arithmetic. Thus, independently of the other two columns Σ and m, the f column, in every result of operations performed with these expressions, as giving a rough value in *artificial Semitones*, or 12th parts of the octave: every like result in the m column will give a considerably more accurate value, in the *artificial Commas* of Nicholas Mercator, or 53d parts of the octave, very nearly: and every result of like operations in the Σ column, will give rigidly accurate results, in all such Euharmonic or untempered calculations as are alluded to above, and will approximate to the truth, abundantly sufficient for nearly every practical purpose of Harmonics, being extremely near to the 612th parts of the octave, and to the 11th parts of the major comma.

When *Tempered Systems* are to be calculated, fractional parts of the major comma, expressed in Schismas, may be joined with these artificial commas without at all disturbing the consistency of their results: thus, if the *Isotonic* scale of equal Semitones were required to be calculated, the flat temperament of the Vth is known to be extremely near to $\frac{1}{11}$th of a major comma, which is Σ, and the true Vth being 358Σ, 357Σ is the Isotonic fifth; 12 of which, or 4284Σ, prove to be just equal to $7 \times 612^{\Sigma}$, as should be the case. If all the three columns of my notation had been here used, a greater degree of exactness only equal to m, or the $\frac{1}{1400}$th part of a comma, would have been gained thereby.

Again, if a *Mean-Tone* Douzeave were required to be calculated, where $\frac{1}{4}$c is the flat Temperament of the Vth; $358 - 2\frac{3}{4}, = 355\frac{1}{4}$ is its tempered fifth: which multiplied by 11, gives $3907\frac{3}{4}\Sigma$, and this taken from 7VIII or 4284Σ, leaves $376\frac{1}{4}\Sigma$, or V $+ 18\frac{1}{4}\Sigma$, as the wolf fifth of this system (usually G♯eb) as is well known, although I now perceive that I have inadvertently called it 21Σ, in the Phil. Mag. vol. 36, p. 45.

I can now proceed to the main object of the present Letter, viz. to shew how the Notes of Professor Fisher's *proportionally-tempered Douzeave*, in your 195th page, may be expressed in these artificial commas (and decimals of them) with greater accuracy, than in the 5-place recip. logs. in which they are now expressed; and in which state, I have hopes of this new Scale of Intervals, deduced with so much ingenuity and labour by Professor F. attracting, in this country at least, a somewhat greater share of attention from the *practical* Musicians and Tuners, than, in its present logarithmic denomination, it seems to me likely to obtain, for reasons which have already been given herein.

By beginning at the bottom of the Table in page 194, and progressively adding together the numbers therein, the value of each Note of the Douzeave will be had in 5-place recip. logs.; B for instance, being ·27208; let this be subtracted from the value of B in the last column of my first Table, and the difference will be found = ·0009212,72; and this difference we must convert into Schismas and decimals by dividing by the value of Σ in the Table, or by ·0004901·07; and thus we get 1·8797Σ, as the flattening or deduction to be made from 555Σ, the artificial commas of B; which thereby becomes 553·1203Σ, as in col. 2 of the Table II. following. By proceeding in a similar manner, the ten other artificial commas and decimals in this Table may be calculated.*

* It is a more ready and correct mode, than by common division, to use *Logometric* Logarithms, (see Edin. Encyc. vol. XIII, p. *72) or the logarithms of the recip. logs.: recollecting that

TABLE II.

Intervals of the Scale, in			Temperaments, of the		
Literals	Artificial commas, or Σs	Numerals	Vths Σs♭	IIIds Σs♯	3ds Σs♭
c	612·0000	VIII			
B	553·1203	VII	2·9	w 13·8	3.0
B♭	512·6776	7	2·2	1·4	w 22·7
A	454·1447	VI	2·8	♭ 0·2	3·1
G♯	397·9991	Ext.♯V	w♯7·9	w 17·0	5·9
G	355·2420	V	2·2	0·9	3·6
F♯	296·2000	IV	3·3	w 19·5	3·1
F	256·5327	4	2·5	0·6	w 19·5
E	197·3246	III	2·2	3·7	3·1
E♭	151·8974	3	♯2·8	6·3	w 16·7
D	99·0776	II	2·9	0·1	3·6
C♯	38·9328	I	♯1·1	w 20·6	2·6
C	0·0000	1	2·8	0·3	9·1
			−23·8	+84·2	−96.0
			+11·8	−0·2	
1	2	3	4	5	6

The three first columns of the above Table can need no further description; except mentioning, that in case the f's

3·6902910, is the constant log. log. for reducing 7–place recip. logs. to logs. of *Schismas ;* and such is likewise the constant addend for reducing Schismas to recip. common logs. In the above example the log. of 9212·72 is 3·9643878 ; from which take the constant log. log. 3·6902910 (or log. of 4901·07) and 0·2740968 remains, whose number is 1·87974Σ as above.

In this manner also, may ratios involving other primes larger than 5, be reduced to my notation: if for example, the false minor Third $\frac{6}{7}$ mentioned in your 195th page, were given: the Tabular recip. log. of $\frac{6}{7}$ (or log. of $\frac{7}{6}$) is ·0669467,90, which falls short of E♭ in my 1st Table, by ·01224344,56 ; from whose log. take the constant log. log. of Σ, and we find the number answering to the remainder to be 24·9628Σ ; and therefore $\frac{6}{7}$=136·0372Σ+3f+14m ; where, for the purposes of Temperaments, the first of the two last terms, or the f's, may always be neglected, as not affecting the results, and so may the last term or the m's, and the artificial commas only be used, unless sometimes, and where extreme accuracy is wanted, as will be further shewn.

and m's are wanted, they are the same as in Table I; and in order to obtain the numbers in the remaining columns, octaves must be stated above col. 2, for the Notes c♯, d, e♭, e, f and f♯, by adding 612Σ to each of the corresponding notes, from C♯ to F♯.

It must be recollected, (as is shewn in Table I.) that the three perfect concords whose Numerals stand at the heads of cols. 4, 5 and 6, are 358Σ, 197Σ and 161Σ respectively: and the mode of obtaining the numbers in these three last columns, will then be made evident, by two examples, viz. 1st, in order to calculate the Temperaments of the Vth above B; from the value of its upper note f♯ or 908·2000, take the value of B or 553·1203, and the remainder is 355·0797Σ, which being less than 358Σ, shews the Temperament to be flat, as is expressed at the top of the column, and the difference of the two last numbers is 2·9203Σ, the Temperament required, but only the two first of these figures is entered in the Table, for reasons which will appear in the Note which is annexed.*

* Rather more exact results than the Schismas and tenths which are set down in Table II, might be obtained, by multiplying Professor Fisher's Temperaments, in his XIIth Table, by 0·0204037; and this method may be used for checking my Table. The reasons why only the first place of decimals of Σs are set down in my Table are, because this is a sufficient degree of exactness for the arranged Table of Temperaments and remarks thereon, which I intend further on; and because, when more places of decimals are required to be *true*, some corrections must be made, for the m's that are overlooked in the above calculations, by artificial commas.

The f's or second terms of my Notation, *do not occasion errors* in any of these calculations; nor do the m's do so, in the Temperaments of 8 of the Vths viz. on C, E, F, F♯, G, A, B♭ or B; or in 6 of the IIIds, viz. on C, D, E♭, E, F or G; or in 5 of the 3ds, viz. on C, E, G♯, A or B. The corrections of the Vth Temperaments are as follows, viz. those on C♯, D, and E♭ require to be altered m (or ·007862Σ) viz. the Temperaments that are ♯, to be decreased, that which is ♭, increased: and the wolf on G♯ requires to be increased 2m (or ·015724Σ.) The IIIds Temperaments require correcting thus; viz. those on C♯, F♯, A and B♭, to be altered m: the ♯ Temperaments to be increased, and the ♭ one decreased; and the Temperaments on G♯ and B, require to be increased 2 m. And in the 3ds column, the Temperaments on

2dly. We will suppose that I was at first at a loss to recollect, which is the note in the upper octave, that limits the major third above B; I have, for removing this difficulty, only to add 197 to 553, which gives 750Σ; and to observe that this is the nearest to e♭, which is 763·8974Σ; from this therefore, I must take B or 553·1203, and 210·7771 remains; which exceeds 197, by 13·7771Σ, and shews this last to be the sharp Temperament of this major third wolf.

Besides distinguishing those Temperaments in col. 4, which differ from the title thereof, in being *sharp*, instead of *flat*, I have added a w to distinguish the fifth wolf; the same remark applies to col. 5, as to the temperament of the IIId on A being *flat*, and to the four major third *wolves*, and also to the three minor third wolves, in col. 6. I have at the bottom of the columns, added up the sharp and flat temperaments, in order to shew that the *Sum* in col. 4 is —12·0Σ; in col. 5, =+84·0Σ; and in col. 6, =—96·0Σ; these † being *general properties* of all Douzeave systems: which, if my knowledge and memory correctly serve me, I was the first to publish, in the Phil. Mag. Vol. 28, plate 5, and to demonstrate in Vol. 36, p. 43.

The *order* of the several concords, as to their degrees of harmoniousness, measured by their Temperaments, to the nearest tenth of a Schisma, or $\frac{1}{110}$ of a comma, are as follows:

C♯, D, F♯, G and B♭, require to be altered m, and those on E♭ and F, require correcting 2 m; all of these, by increasing the Temperaments.

One example must suffice; in the Text, the Temperament of the wolf IIId on B, has already been found 13·7771Σ, which it now appears, is to be increased ·0157Σ, and made 13·7928Σ. This trouble might have been lessened, if the corrections in Table X. had been calculated at first in Schismas and decimals. by applying the numbers in Table IX, to the numbers of an Isotonic Douzeave, composed of multiples of 51Σ.

† When the corrections of the Temperaments, on accont of the m's, are made, the casting will stand thus, viz. —23·7527 +11·7448, =12·00079Σ; +84·2669 —·2040, =84·0629Σ; and —96·0708Σ, which accord with my determinations in the Philosophical Magazine.

TABLE III.

IIIds on (and 6ths below) D 0·1, A 0·2, C 0.3, F 0·6, G 0·9, B♭ 1·4, E 3·7, E♭ 6·3; B 13·8, G♯ 17·0, F♯ 19·5, and C♯ 20·6.

Vths on (and 4ths below) C♯ 1·1, B♭ 2·2, G 2·2, E 2·2, F 2·5, C 2·8, E♭ 2·8, A 2·8, B 2·9, D 2·9, F♯ 3·3; and G♯ 7·9.

3ds on (and VIths below) C♯ 2·6, B 3·0, F♯ 3·1, E 3·1, A 3·1, D 3·6, G 3·6, G♯ 5·9, C 9·1; E♭ 16·7, F 19·5, and B♭ 22·7.

It will be seen from Professor Fisher's Table in p. 32, that a very decided majority of organ pieces, in the *major* mode, are set in G and D: and a no less marked majority of those in the *minor* mode, in A and D; and it is on this account that I have drawn a black line, to separate the minor thirds in the above Table: the Vths are placed in the middle line, for more ready comparison with the IIIds above and the 3ds below; and the *wolves* are separated by semicolons.

I beg now to congratulate Professor Fisher on the happy result of his ingenuity and labour, in calculating this Douzeave: viz. as to the very near agreement exhibited above, with what I understand to be the present practice of all the best Tuners of organs; I mean, as to the exceedingly small Temperaments of that very important concord the *major Third*, in the five most important Keys, viz, G, D, C, F and A; as to the very moderate temperament of this concord, in the Keys B♭ and E; and as to the four IIId wolves, (which are, alas! inseparable from a Douzeave Scale,) falling in those Keys, where all judicious Tuners have been used to throw them; and the least of these wolves falls in the Key of B, which oftenest occurs. The only thing which strikes me as an unlooked-for anomaly as to the IIIds, is, the Temperament on E♭, being so considerable, as more than half a comma.

With regard to the fifths, considered with relation both to the major and minor modes, in the three important Keys G, F and E, the Temperaments are less than in the Mean-Tone system (or $2\frac{3}{4}\Sigma$,) now so generally used on the organ: in the three other important Keys D, C and E♭, the Temperaments are but a trifle greater than the Temperaments in use; and the Vth wolf falls in the same Key, and is considerably less than half of the usual quantity; owing to two others of the fifths being in small degrees *sharpened*, which seems a great and important novelty.

As to the *minor Thirds*, the two most important Keys, A and E, have Temperaments which but very little exceed those in use, and in neither of the three next most important Keys D, G and B, does the Temperament one-third exceed those of the Mean-Tone system; and lastly, the three 3d wolves fall in the three Keys, to which the practical Tuner assigns them; agreeably to what is stated in my Temperament Theorems, Phil. Mag. vol. 36, p. 42: the 11th Scholium to which defines the chief properties of the *Equal-harmony Douzeave* of Professor Fisher, in his 3d proposition.

I beg leave to remark, that I have long been impressed with the importance and desirableness of what Professor Fisher has now performed for the Musical world, as far at least as Organ Music is concerned, as will be seen by reference to the work last quoted, vol. 26, p. 176; and vol. 27, p. 319 and 320.

I am not aware that any one before me, had published the accurate and very simple *mode of calculating Beats*, which Professor Fisher has rather too briefly mentioned, at the bottom of page 181: many years ago, I deduced it as a corollary from the 202d proposition of Emerson's Algebra, whose Theorem I have quoted in the Edinb. Enc. Vol. III, p. 369, and there first published my Theorem.

In a future communication to you, I wish much that Prof. Fisher would mention the Temperament, or else otherwise define the system, which he has entitled the *French* one, in page 198: and also say, whether at the top of p. 31, he does not mean ♯Vth on C, and ♯VIth on F?

I regret exceedingly that the calculations for Table IV, in page 34, were abridged of their three last places of figures, particularly the two first of these, and earnestly request, that Professor Fisher will yet supply these, through the medium of your pages, and he will still further oblige,

Sir

Your obedt. humble servt.

JOHN FAREY Senr.

Howland Street, London, 30. *April*, 1819.

P. S. I regret very much, to find the *Geological Observers* in your vast and interesting country, so very commonly to omit *stating bearings and distances*, from known *Towns*, as well as nearest distances and bearings from known *Streams*, as the means of more pefectly fixing *the localities* of their particular observations, and conveying an idea of the same to Readers here and elsewhere, who can have no other helps than Maps, and those perhaps, not on the largest scale, or latest construction. It is an equal source of disappointment and regret, that *the direction and degree of Dip*, is not invariably mentioned, wherever Rocks or Strata are observed. Incomparably the most simple and useful mode of denoting the latter, is, by *the proportion* of the measure of *level*, to one of perpendicular *fall:* as for instance, Dip NE 1 in 5, or SW 1 in 2, &c.; and $\uparrow^5$ or $\downarrow_2$* may on Maps, denote the same things, as I have long practiced. I hope Mr. Editor, that you will join me herein, and not fail to reiterate the request, that *Observers of Strata, of useful Minerals*, in particular, like Coal, Limestone, Freestone, Ironstone, Gypsum, Clays &c. will always include the above particulars, in their descriptions sent for your work.

MEDICAL CHEMISTRY.

PRUSSIC ACID.

ART. VII. *Abstract and translation of* DR. F. MAGENDIE'S *late pvblication on Prussic Acid—by the* EDITOR, *with remarks.*

THE memoir of Dr. Magendie of Paris, presented to the academy of sciences of that city, Nov. 17, 1817, on the uses of the Prussic acid in certain diseases, particularly in Phthisis Pulmonalis, was published, soon after, in English, in the Journal of the Royal Institution of London, and is generally known in this country. The subject is one which

* Mr. Farey's marks in his MS. are arrow heads; no characters of nearer resemblance were at hand.

could not fail deeply to interest society at large, as well as the faculty of medicine. As far as I am informed, these researches have not been so extensively prosecuted in the United States as could be desired,*—partly from the difficulty of obtaining the acid, which is no where sold in the shops, and which can be prepared only by a practical chemist; and partly, in all probability, from negligence and incredulity. Having received from Paris, a recent publication by Dr. Magendie, on this subject,† containing many additional facts, ascertained by himself, and by various other enlightened men, in different countries; and, not having met with any translation of, or abstract from it, I have thought, that I could not do better, than to present the substance of this new memoir to my readers, partly by translation and partly by abstract, and analysis.—For obvious reasons, I have not drawn any thing from the first memoir of Dr. Magendie, which he has republished in due connexion with his present work; still, it will be useful to remember, that the conclusions which he drew at that time, from his experiments, on prussic acid were:

1. That pure prussic acid is eminently *poisonous* and altogether improper to be used in medicine.

2. That, diluted with water, it can be advantageously used for the cure of *nervous* and *chronic coughs*.

3. That it may be useful in the *palliative* treatment of *phthisis*, by diminishing the intensity and frequency of the cough—moderating the expectoration and favouring sleep.

4. That there is some reason to hope, that it may become useful in the *curative* treatment of *phthisis pulmonalis*, especially when it has not yet passed its first stage.

* Some favourable results were obtained by my late lamented friend Dr. E. D. Smith, Professor of Chemistry &c. in the college of South Carolina; and, being published in the newspapers, deservedly excited a good deal of attention. A few partial trials in phthisis and asthma have been made by some of the faculty in New-Haven and generally with favourable results: I am not informed how far the subject has been prosecuted in our larger cities. It may be respectfully suggested to the faculty that on account of the peculiarly volatile and decomposable nature of prussic acid, particular attention is necessary to ascertain, whether the acid used is of sufficient strength: it should have very decidedly the odour of peach blossoms, but more intense, so as to be rather oppressive, if much of the vapour gets into the nostrils.

† Recherches physiologiques et cliniques sur l'emploi de l'Acide Prussique ou Hydro—cyanique, dans le traitement des maladies de poitrine et particulièrement dans celui de la Phthisie pulmonaire, &c.—Paris, 1819.

This able and enlightened physician then goes on to observe :—

" In publishing these researches, almost three years ago, my principal object was to attract the attention of practitioners to a subject which appeared to me worthy of interesting them.

" My wish has been accomplished even beyond my hopes.

" The medical faculty of Paris have placed the Prussic acid in the number of remedies recommended by the new Codex ; and many physicians, both French and foreign, have not only repeated but have greatly extended my experiments." (Observations.)

" It is therefore with pleasure and gratitude that I proceed to record the results obtained by my brethren.

Dr. Fontanelles in a pamphlet published in 1817 at Millan, expresses himself thus :"—

" I have obtained wonderful results from the prussic acid prepared according to the process of Scheele, upon four children of the same family affected by the whooping cough: I put three drops of the acid into an ounce of distilled water, and caused this mixture to be given every two hours by a spoonful at once ; the children themselves, frankly stated to me, that having commenced the use of this remedy in the morning, they did not experience at night, those paroxysms of coughing, which had threatened to suffocate them :—that they slept well, and that on the fourth day from their beginning the use of this liquid, the whooping cough disappeared from two of them, and from the other two a few days after."

The experiments of Dr. Fontanelles were suggested by reading Dr. Magendie's memoir. Dr. Manzoni at Padua in an augural thesis, states various interesting observations, derived chiefly from the practice of Dr. Brera. A woman, aged twenty-nine years, of a sanguine sthenic and irritable temperament, was brought to the clinical institution at Padua, without having received any relief, although advanced to the seventh day of a very severe pleuro-peripneumony. Ten ounces of blood were drawn—and a little time after, eight more ; thirty drops of prussic acid were given in an emulsion of gum arabic, during the day, and twelve more in the night ; the following day, the urine became copious, and full of sediment ; after this the expectoration diminished—

the respiration became more easy—the cough less wearing—the pain in the side gradually ceased, and in a few days, by this mild and simple treatment, the patient became quite well.

Dr. Manzoni, in the same thesis, assures us that the professor derived the most signal advantage from the use of the prussic acid in bronchial inflammation; in catarrhs, and in phthisis. A man, thirty-four years old, rapidly verging towards the tuberculous state of phthisis, by taking the prussic acid, in emulsion of gum arabic, had his purulent expectoration both ameliorated and diminished, and his life, (before very wretched) prolonged.

Two women with chronic catarrh, attended by copious and purulent expectoration, in a short time, by the use of the prussic acid, found the matter changed into simple mucus and left the clinical institution almost in perfect health.

In professer Brera's private practice many similar cases occurred. Among others, the following memorable instance is cited. A noble lady, affected by a commencing phthisis, was seized with such a copious bleeding at the lungs, (hémoptysie) that in a short time she was at death's door; bloodletting had been resorted to in vain, when Dr. Brera prescribed under the form of pills, one hundred drops of the prussic acid, to be taken in the course of the night; this, as he expresses it, *miraculously* arrested the bleeding. The use of the prussic acid, in doses of from thirty to fifty drops, in twenty-four hours, continued for five days, restored this lady to perfect health without leaving the slightest trace of a pulmonary affection.*

Dr. Brera, by the use of prussic acid, with the leaves of the atropa belladona, succeeded in curing perfectly a schirrous affection of the womb, complicated with a syphilitic affection.

In another case, a noble lady at Padua, aged twenty-seven years, of an irritable temperament, placed herself under the care of Dr. Brera. She had a chronic uterine affection,

* Dr. Magendie very justly condemns the administration of the prussic acid *in pills*, because, from its excessive volatility, especially at an elevated temperature, much of it must be lost; this is the reason why this lady could take with impunity (or rather *appear* to take) one hundred drops, for had she really taken this quantity it might have been fatal. It is much better to put the acid into some liquid vehicle, water—mucilage of gumarabic, or almost any simple fluid.

marked by extreme pain and great heat; ("au fond de l' uterus et par un ecoulement mucoso—purulent par le vagin. L' ouverture du col présentait au toucher une chaleur plus forte que la chaleur naturelle et un assez grand nombre d' inégalitiés; les menstrues se montraient sans regularite,") with the fever, there was uterine colic, constipation, and hemorrhoidal tumours, which had been of considerable standing. On the twelfth day of the disease, this lady was seized with a violent (and with her) an unparalleled uterine hoemorrhage; which proved uncontrollable by any of the common means. If the bleeding diminished in a degree, the pains of the uterus, and of the piles, became intolerable; and on the contrary, if these pains were assuaged, there was great reason to fear that she would sink under the hoemorrhage. In this trying crisis, Dr. Brera gave ten drops of prussic acid, in the form of pills, every hour, and directed that they should be continued till they had produced a marked effect upon the vital powers. Scarcely had twenty drops of the acid been given, when irregular palpitations, great anxiety, and vertigo were experienced. The acid was then discontinued, and a simple infusion of chamomile substituted. Soon after, the skin, which to that time had been dry and hot, became covered with an abundant perspiration—the hoemorrhoidal and uterine pains ceased—the bleeding stopped—the bowels became free—the urine abundant and healthy, and all the other numerous and distressing affections disappeared; mild injections of the prussic acid were used towards the termination of the disease. It results from the observations of Dr.'s Brera and Borda, who in 1810 made much use of this acid in sthenic diseases, that it is one of the best things to calm the movements of the heart—to diminish febrile irritation, and to encounter the most severe inflammations. Observations of this kind have been much multiplied in Italy. At Padua, most diseases are much complicated by worms, (vers lombricoïdes,) in the intestinal canal, which are very promptly expelled, and even while still alive, by the use of the prussic acid.

The experience of Dr. Granville in England is cited by Dr. Magendie. Dr. Granville mentions cases of advanced consumptive patients, in whom the prussic acid produced sensible amelioration, but without effecting a cure. A young man and woman, however, who attended the gratuitous consultation of Dr. Scudamore, exhibited every appearance of confirmed pthisis; they had a worrying cough—emaciation—frequent pulse—night sweats—debility—purulent expectoration, and that particular form of the nails, which commonly accompanies these symptoms. The Dr. gave them both the prussic acid in the dose of ten drops a day, and soon had the pleasure of seeing them restored to perfect health, in which condition, after the lapse of eight months, the young woman called to thank her physician.

Several cases are cited of English patients, affected with hectic fever, and sympathetic cough, who were greatly relieved by the prussic acid, and some of them appear to have been cured. The cases, although interesting, are too long to be detailed in this abstract, and the symptoms arose from different causes. In one case, a hectic fever, with cough, &c. grew out of a long continued inflammation of the liver, attended with tubercles and adhesion; in another it arose from miscarriage and grief; in a third, from a schirrous affection of the ovarium; in a fourth, from typhus fever, ending in delirium; and in a fifth, (a lad of ten years old,) it came on without any obvious cause. The two last cases were of a very desperate character, and yielded to the use of prussic acid, when all other means had failed.*

Asthma of six years standing, in a man of advanced age, was greatly aggravated by cold dampness or exercise, and was replaced by a constant dry cough whenever the asthma was assuaged; the disease was augmented by food and deprived the patient of sleep, and was attended by a swelling of the limbs, and chills and fever at evening; this formidable complaint, with all its concomitant maladies, was so much relieved by prussic acid, that the patient acquired a degree of comfort to which he had long been a stranger; he could go up stairs without inconvenience, and constantly arrested the progress of his complaints by a recurrence to the prussic acid, whenever they menaced a return.

In colds and catarrhs especially where, by neglect, alarming or troublesome symptoms were supervening, the prussic acid appears to have been very useful and in most cases entirely effectual.

In one case a woman, five months advanced in her eighth pregnancy, and during the five months affected with a vio-

* Vid Recherches, &c par. Magendie Docteur, &c. pp. 33 to 38.

lent convulsive cough, attended by extreme irritation, was entirely relieved by the prussic acid, without sustaining the slightest inconvenience from her peculiar situation.

Dr. Granville's own children, four in number and the youngest an infant at the breast, were all attacked by the whooping-cough, which soon became very violent with the usual attendants of suffocation, vomiting, tears, extreme tension of the blood vessels of the head, severe head ache, deprivation of sleep, &c. In one week they were all cured entirely by the exclusive use of the prussic acid.

Dr. A. T. Thomson in a communication to Dr. Granville says: "the diseases in which I have prescribed the prussic acid are catarrhal affections accompanied by cough, and in chronic coughs."—"I have used it with very great success in catarrhal affections which actually reign epidemically in the part of the country where I live. The disease begins by chills, which are soon followed by a febrile excitement, sneezing, hoarseness and thirst, and a hard cough which comes by paroxysms, is more frequent during the night and deprives the patients of sleep; the tongue is furred, the bowels costive and expectoration very difficult. Since I have used the prussic acid I have rarely had recourse to blood letting, although it has been indicated by the pulse, but I have been on my guard knowing the action exerted by the prussic acid upon the circulation. I commonly begin by purging the patient, then I give the acid dissolved in distilled water, or in a simple almond emulsion; I take care to proportion the dose to the age and strength of the individuals, gradually increasing it till the cough has ceased. I begin with adults by giving them every two or three hours, two drops in a spoonful of the vehicle. For children between four months and one year, I have prepared the following formula.

R. Prussic acid, - - -	2 drops.
Distilled water, - - -	9 fluid drachms.
Syrup of tolu, - - -	1 fluid drachm.

Mix them, and give two small tea spoonfuls every three hours.

The strongest dose in which I have ever administered this acid, has been twenty-four drops (min) in a day for an adult, and six drops (min) for a child. The first and the most speedy benefit derived from the use of the prussic acid in catarrhal affections, is to procure sleep, and to diminish the frequency of the paroxysms of coughing. The next day, we find the pulse less quick and hard, and by degrees the cough becomes less violent. I have not observed that it produces expectoration, but it certainly diminishes the cough, and renders it less laborious. The intestinal canal is gently excited, so that I have rarely been compelled to give purgatives a second time. By the moderate use of certain stimulants, we easily obviate the languor which sometimes in feeble and aged subjects, follows the use of the prussic acid ; and when the cough is alleviated, we can certainly remove the debility by the use of the ammoniacal tincture of iron, dissolved in brandy and water.

Among the particular cases mentioned by Dr. Thomson, are some sufficiently remarkable.—A man of thirty-seven years of age, habitually very healthy, and of a plethoric habit, had been for several weeks tormented with a very wearing cough, which almost deprived him of sleep ; the paroxysms became constantly more and more frequent ; his throat was much affected—he had a great hoarseness, with a short and wheezing respiration ; after a cathartic, he took the prussic acid every two hours—dose, two drops in twelve drachms of water. Immediately he gained sleep—his cough abated—expectoration became easy—the pulse grew soft, and in three days all the symptoms of the disease were appeased.

A lady, aged forty years, of a sanguine and irritable temperament, and naturally gay, had been for two years labouring under the pthisis trachealis. Having the first year derived no benefit from medicine, she neglected the complaint the second year, and took medicines only when the symptoms were aggravated. The disease was marked by a laborious cough—a perception of dryness in the throat, with danger of immediate suffocation, and a general inflammation and swelling of the back part of the mouth. These symptoms, accompanied by fever, and great irritability, never entirely ceased ; they diminished at intervals, especially in summer, but returned with increased violence with every exposure to cold. She was advised to quit England for warmer climates, but this was not executed. She grew worse—her pulse was small, quick, irregular, and varying with the state of her mind. She had palpitations, and very little repose, and that much disturbed. Her physician happened to come in (Jan. 26,) while she was in a violent paroxysm of coughing, resembling croup, and with imminent danger of suffocation; her pulse as before, the back part of the mouth very much inflamed, and furrowed, as it were, with large vessels, injected with blood.

Having been purged, prussic acid was administered in the following prescription:—

R. Prussic acid,	- - -	12 drops.
Rose water,	- - -	half a fluid ounce.
Syrup of popies,	- - -	3 fluid drachms.

Mix them, and take a large tea spoon full every two hours.

The next day the patient was much better; had enjoyed a better night than for several months, without cough or perception of heat or oppression in the breast, and the pulse were more regular, and more moderate and full. The prussic acid was continued four days, each time augmenting the dose two drops. The fourth day nausea occurred, and the symptoms being much better, the remedy was discontinued. From that time she remained perfectly well, had no relapse, and considered her restoration as almost a miracle, and believed herself perfectly cured. The writer dates on the 26th of February, and says, that in his view she still needs much care, and a particular regimen, and that the disease, if not entirely removed, is arrested in its progress.

A military gentleman being affected every winter with a spasmodic cough, experienced effectual relief from the use of the prussic acid, and being called by the service to another country, took a phial of it with him, as his best resource on a recurrence of the complaint.

A gouty patient, troubled with a violent dyspepsia, was attacked by the epidemic catarrh, and was relieved by the prussic acid.

Dr. Kerkaradec, of Paris, relates his experience in the use of the prussic acid.

In one case of nervous cough, in a patient of forty years of age, it was ineffectual, probably because it was given in very trifling doses, and often omitted by the patient, but it does not appear that it did any harm.

In another patient, in the last stage of consumption, it was given in very small portions, but it appeared rather to aggravate the cough, and its use was abandoned; the patient died soon after: it does not appear that in this case it accelerated the death, which seems to have occurred because the disease had run its course. It does not seem to be useful in the last stage of consumption, but, perhaps it would be difficult to point out any thing else that is.

Dr. Kerkaradec relates another case, of a child of seven years, which for five months was afflicted with a dry cough, constant and very wearing, attended by pain in the left side of the chest, by fever, &c. The usual remedies were applied for three months, without success, when the whooping cough supervened in a violent degree, and after running on three months, was spontaneously cured. The dry cough then returned, and after a month more, was found to be constant; the pain in the side recurred, and the left side of the chest gave a bad sound; the tongue was white—the appetite gone—the bowels were constipated—enlarged, and somewhat sensible to the touch; there was a constant quickness of pulse, considerable fever, a tendency to drowsiness, and a severe pain in the head. The usual remedies were applied with some mitigation of the symptoms, but the cough constantly preserved its peculiar character. The prussic acid was then administered, twelve drops in three days, taken by spoonfulls once in two hours. ("La dose fut d'une cuillerée à café toutes les deux heures." (At the end of three days, the cough began to diminish, and three potions more, into which there entered fifteen drops of the medicine, completed the cure, and at the end of seven months there had been no return of the complaint.

A little girl three and a half years old had a whooping cough of five months standing—the fits of coughing were very violent, and at least twelve in a day, producing mucous expectoration, with a great deal of blood; the disease was assuaged by leeches applied to the left side of the chest, where they were indicated by the sound; the blood ceased to appear, and the cough was less frequent, and less violent. The prussic acid, twelve or fifteen drops, administered in the usual manner,* in potions, removed the cough after two potions, and in twelve days it wholly disappeared.

* Viz. where twelve were employed before.

The little brother of this child, nine months old and at the breast, was immediately relieved from an incipient whooping cough by the same means.

A child of four and a half years was affected for five months, by a whooping cough, for the cure of which all the common remedies and especially the syrup of ipecacuana had been applied in vain. Fifteen drops of the prussic acid were then administered in the course of three days; this remedy was then discontinued for four or five days, on account of a febrile excitement which lasted that length of time; it was then resumed and the cough disappeared in five days more; it sometimes recurred at distant intervals, owing to wet weather, but bathing caused it finally to disappear.

A lady of twenty years of age, of a plethoric habit, but enjoying perfect health, and with regular habits in all respects, ("et la quantité, de sang évacué tous les mois était abondante") was, without any obvious cause seized with acute pains in the stomach, followed by a cough, which occurred in violent paroxysms but without any appearance of whooping cough. Being of a gouty family, and having in her childhood had some gouty affections, she was treated accordingly but without benefit; her sufferings, and her cough continued, and she lost her bloom and her flesh, and was very apprehensive of a consumption. She took twelve drops of prussic acid, a day, in solution of gum arabic and after a few days the cough diminished; she then took twenty-one drops a day, for some time and was entirely relieved from her cough, and recovered very good health. The pains in her stomach are of rare occurrence and not severe.

In summing up this mass of evidence, Dr. Magendie observes, that the remarkable accordance, between the observations of distinguished men in various countries of Europe, appears to be an irresistible proof in favour of this new medicine, and of its perfect innocence, even in large doses, administered with prudence but without unnecessary timidity.

He remarks, that since the publication of his first memoir, he has been much occupied in the administration of the prussic acid, especially in cases of pulmonary phthisis; that he has neglected no opportunity to administer it in the first stages of this disease, but that he has given it to many in various stages; that in some instances he has seen it in common with all other remedies, completely fail, and the unhappy patients pursue their downward progress to the grave: that on the contrary, in a great number of instances, he has seen a sensible amelioration in the most distressing symptoms; the cough has become less frequent; the expectoration more free, and the sleep more prolonged.

"It is (adds Dr. Magendie,) with satisfaction easily understood, that I have seen the symptoms of phthisis completely cease in eight (seven?) different circumstances; in three children from four to six years, in a young woman of fifteen, in another of twenty, in a young man of twenty five, and in an old man of sixty-six; and it is with the most anxious solicitude, that I have waited their state of health, for the purpose of learning, whether the evil is really arrested, or only suspended in its progress. Time only can decide; I can only say that the two ladies whose cases were reported in my first memoir, and whose cure is of four years standing, continue to enjoy perfect health."

With respect to the dose, Dr. Magendie remarks, that as the effect of the prussic acid is very different in different individuals, it is necessary to begin with a moderate dose; but there is no danger in encreasing it provided its effects are not manifested, and that he has, many times, gradually augmented the dose to half a drachm in twenty-four hours without producing the slightest inconvenience.

As to the preparation of the acid, Dr. Magendie finding that the acid of Scheele is of variable strength, prefers that prepared by the process of Gay Lussac, which consists in decomposing the prussiate of mercury by muriatic acid and collecting the acid in a cold receiver. This acid is to be diluted with six times its volume or eight and a half times its weight of distilled water.

Remark. As the preparation of the acid of Gay Lussac is not without danger to the operator, on account of its terrific energy, even in vapour, it is presumed that having once ascertained how much of Gay Lussac's acid, a given weight of Prussiate of Mercury will afford, it will be sufficient to place at once in the receiver, eight and a half parts of water and thus obtain a diluted and much less dangerous acid.

I have found very unpleasant effects even from breathing the vapour of the prussic acid when I have prepared it after the process of Scheele and my assistants have been much incommoded with vertigo, nausea and even swooning.*

Dr. Magendie gives the following formulas for the exhibition of the acid.

Pectoral Mixture.

R. Prussic acid medicinal,	- -	1 drachm,
Distilled water,	- - -	1 pound,
Pure sugar,	- - - -	1 ½ ounce,

F. S. L. Take one table spoonful in the morning and one in the evening when going to bed.

Pectoral Potion.

R. Infusion of ground ivy,	- -	1 drachm,
Prussic acid, (medicinal)	- -	15 drops,
Syrup of marsh mallow,	- -	1 ounce,

F. S. L. Take a potion by spoonfulls, once in three hours.

Sirup cyanique, or Prussic Syrup.

R. Syrup of sugar, perfectly clarified,		1 pound,
Prussic acid, (medicinal)	- -	1 drachm,

Mix them exactly.

This syrup is used to add to the pectoral potions and as a substitute for the other syrups.

I have procured for the use of medical friends, directly from Dr. Magendie several vials of Prussic acid, such as he

* A bottle containing probably an ounce of the prussic acid of Scheele being accidentally knocked from the table, in my laboratory and broken, the vapour exhaled (although the liquid was instantly covered with ashes and swept into the fire) affected me powerfully, and particularly at night my muscular and intellectual powers seemed almost prostrated; an assistant was ill in the evening and in a similar manner; the next morning he swooned on rising from bed and fell upon the floor—he remained very feeble although without pain for several days, but gradually recovered by using mild stimulants; (aqua ammoniæ, wine, &c.) his pulse was very feeble and small, and his nervous and muscular powers very greatly enfeebled.

As it appears to be one of the great prerogatives of the prussic acid to *prostrate muscular and nervous energy*, it may be asked whether in case of hirnea and luxations it might not be useful in overcoming the muscular resistance which often opposes their reduction, and, whether it may not unlock the fatal rigors of spasm even in tetanus itself?

employs, and although this fluid is liable to decompose, and to become weak, especially by careless keeping, these vials appear to have arrived in good order; the acid remains colourless, whereas it is coloured if decomposed. It was made in Paris, by M. Robiquet.

Dr. Alfred S. Monson, upon whose skill and care every degree of reliance may be placed, will supply practitioners with this acid, manufactured by him corner of York and Elm streets, New-Haven.

N. B. The vials should be kept close stopped and in a dark and cool place; they should be opened as little as possible, should be labelled *poison*, and the *undiluted* liquid by no means tasted; they should be kept where none but discreet persons can have access to them.

Gentlemen who use the prussic acid are invited to transmit their reports of its effects for publication in this Journal; they shall be published either in extenso, or by abstract, and analysis as may appear best.

PHYSICS, MECHANICS, CHEMISTRY, AND THE ARTS.

SUBMARINE NAVIGATION.

ART. VIII. *Description of a Machine, invented and constructed by* DAVID BUSHNELL, *a native of Saybrook, at the commencement of the American revolutionary war, for the purpose of submarine navigation, and for the destruction of ships of war; with an account of the first attempt with it, in August* 1776, *by* EZRA LEE, *a sergeant in the American army, to destroy some of the British ships then lying at New-York. Communicated by* CHARLES GRISWOLD, *Esq.*

TO PROFESSOR SILLIMAN.

LYME, *Conn. Feb.* 21*st.* 1820.

Sir,

IT is to be presumed that every person who has paid any attention to the mechanical inventions of this country, or has looked over the history of her revolutionary war, has heard of the machine invented by David Bushnell, for submarine navigation, and the destruction of hostile shipping. I have thought that a correct and full account of that novel and original invention, would not be unacceptable to the public, and particularly to those devoted to the pursuit of science and the arts.

If the idea of submarine warfare had ever occurred to any one, before the epoch of Bushnell's invention, yet it may be safely stated, that no ideas but his own ever came to any practical results. To him, I believe, the whole merit of this invention is unanimously agreed to belong.

But such an account as I have mentioned, must derive an additional value, and an increased interest from the fact, that all the information contained in the following pages, has been received from the only person in existence possessed of that information, and who was the very same that first embarked in this novel and perilous navigation.

Mr. Ezra Lee, first a sergeant and afterwards an ensign in the revolutionary army, a respectable, worthy, and elderly citizen of this town, is the person to whom I have alluded; to him was committed the first essay for destroying a hostile ship by submarine explosion, and upon his statements an implicit reliance may be placed.

Considering Bushnell's machine as the first of its kind, I think it will be pronounced to be remarkably complete throughout in its construction, and that such an invention furnishes evidence of those resources and creative powers, which must rank him as a mechanical genius of the first order.

I shall first attend to a description of this machine, and afterwards to a relation of the enterprise in it by sergeant Lee; confining myself in each case, strictly to the facts with which he has supplied me.

Yours, &c.

CHARLES GRISWOLD.

Bushnell's machine was composed of several pieces of large oak timber, scooped out and fitted together, and its shape my informer compares to that of a round clam. It was bound around thoroughly with iron bands, the seams were corked, and the whole was smeared over with tar, so as to prevent the possibility of the admission of water to the inside.

It was of a capacity to contain one engineer, who might stand or sit, and enjoy sufficient elbow room for its proper management.

The top or head was made of a metallic composition, exactly suited to its body, so as to be water-tight; this opened upon hinges, and formed the entrance to the machine. Six small pieces of thick glass were inserted in this head, for the admission of light: in a clear day and clear sea-water, says my informer, he could see to read at the depth of three fathoms. To keep it upright and properly balanced, seven hundred pounds of lead were fastened to its bottom, two hundred pounds of which were so contrived as to be discharged at any moment, to increase the buoyancy of the machine.

But to enable the navigator when under water, to rise or sink at pleasure, there were two forcing pumps, by which water could be pressed out at the bottom; and also a spring, by applying the foot to which, a passage was formed for the admission of water. If the pumps should get deranged, then resort was had to letting off the lead ballast from the bottom.

The navigator steered by a rudder, the tiller of which passed through the back of the machine at a water joint, and in one side was fixed a small pocket compass, with two pieces of shining wood, (sometimes called foxfire,) crossed upon its north point, and a single piece upon the last point. In the night, when no light entered through the head, this compass thus lighted, was all that served to guide the helmsman in his course.

The ingenious inventor also provided a method for determining the depth of water at which the machine might at any time be. This was achieved by means of a glass tube, twelve inches in length, and about four in diameter, which was also attached to the side of the machine: this tube enclosed a piece of cork, that rose with the descent of the machine, and fell with its ascent, and one inch rise of the cork denoted a depth of about one fathom. The principle upon which such a result was produced, and also the mechanical contrivance of this tube, entirely escaped the observation of Mr. Lee, amidst the hurry and constant anxiety attendant upon such a perilous navigation.

But not the least ingenious part of this curious machine, was that by which the horizontal motion was communicated to it. This object was effected by means of two oars or paddles, formed precisely like the arms of a wind-mill, which revolved perpendicularly upon an axletree that projected in front; this axletree passed into the machine at a water joint, and was furnished with a crank, by which it was turned: the navigator being seated inside, with one hand laboured at the crank, and with the other steered by the tiller.

The effect of paddles so constructed, and turned in the manner stated, by propelling or rather drawing a body after them under water, will readily occur to any one without explanation.

These paddles were but twelve inches long, and about four wide. Two smaller paddles of the same description, also projected near the head, provided with a crank inside, by which the ascent of the machine could be assisted.

By vigorous turning of the crank, says my informer, the machine could be propelled at the rate of about three miles an hour in still water. When beyond the reach of danger, or observation of an enemy, the machine was suffered to float with its head just rising from the water's surface, and while in this situation, air was constantly admitted through three small orifices in the head, which were closed when a descent was commenced.

The efficient part of this engine of devastation, its magazine, remains to be spoken of. This was separate and distinct from the machine. It was shaped like an egg, and like the machine itself, was composed of solid pieces of oak scooped out, and in the same manner fitted together, and secured by iron bands, &c. One hundred and thirty pounds of gun powder, a clock, and a gun lock, provided with a good flint that would not miss fire, were the apparatus which it enclosed. This magazine was attached to the back of the machine, a little above the rudder, by means of a screw, one end of which passed quite into the magazine, and there operated as a stop upon the movements of the clock, whilst its other end entered the machine. This screw could be withdrawn from the magazine, by which the latter was immediately detached, and the clock commenced going. The clock was set for running twenty or thirty minutes, at the end of which time, the lock struck, and fired the powder, and in the mean time the adventurer effected his escape.

But the most difficult point of all to be gained, was to fasten this magazine to the bottom of a ship. Here a difficulty arose, which, and which alone, as will appear in the ensuing narrative, defeated the successful operations of this warlike apparatus.

Mr. Bushnell's contrivance was this—A very sharp iron screw was made to pass out from the top of the machine, communicating inside by a water joint; it was provided with a crank at its lower end, by which the engineer was to force it into the ship's bottom: this screw was next to be disengaged from the machine, and left adhering to the ship's bottom. A line leading from this screw to the magazine, kept the latter in its destined position for blowing up the vessel.

. . . .

I shall now proceed to the account of the first attempt that was made to destroy a ship of war, all the facts of which, as already stated, I received from the bold adventurer himself.

It was in the month of August, 1776, when Admiral Howe lay with a formidable British fleet in New-York bay, a little above the Narrows, and a numerous British force upon Staten Island, commanded by General Howe, threatened annihilation to the troops under Washington, that Mr. Bushnell requested General Parsons of the American army, to furnish him with two or three men to learn the navigation of his new machine, with a view of destroying some of the enemy's shipping.

Gen. Parsons immediately sent for Lee, then a sergeant, and two others, who had offered their services to go on board of a fire ship; and on Bushnell's request being made known to them, they enlisted themselves under him for this novel piece of service. The party went up into Long Island Sound with the machine, and made various experiments with it in the different harbors along shore, and after having become pretty thoroughly acquainted with the mode of navigating it, they returned through the Sound; but during their absence, the enemy had got possession of Long-Island and Governor's-Island. They therefore had the machine conveyed by land across from New-Rochelle to the Hudson river, and afterwards arrived with it at New-York.

The British fleet now lay to the north of Staten-Island, with a large number of transports, and were the objects against which this new mode of warfare was destined to act; the first serene night was fixed upon for the execution of this perilous enterprise, and sergeant Lee was to be the engineer. After the lapse of a few days, a favorable night arrived, and at 11 o'clock, a party embarked in two or three whale boats, with Bushnell's machine in tow. They rowed down as near the fleet as they dared, when sergeant Lee entered the machine, was cast off, and the boats returned.

Lee now found the ebb tide rather too strong, and before he was aware, had drifted him down past the men of war; he however immediately *got the machine about*, and by hard labour at the crank for the space of five glasses by the ship's bells, or two and a half hours, he arrived under the stern of one of the ships at about slack water. Day had now dawned, and by the light of the moon he could see the people on board, and heard their conversation. This was the moment for diving: he accordingly closed up overhead, let in water, and descended under the ship's bottom.

He now applied the screw, and did all in his power to make it enter, but owing probably in part to the ship's copper, and the want of an adequate pressure, to enable the screw to get a hold upon the bottom, his attempts all failed; at each essay the machine rebounded from the ship's bottom, not having sufficient power to resist the impulse thus given to it.*

He next paddled along to a different part of her bottom, but in this manœuvre he made a deviation, and instantly arose to the water's surface on the east side of the ship, exposed to the increasing light of the morning, and in im-

* It yet remains a problem, whether the difficulty here spoken of will ever be fully obviated. Mr. Fulton's torpedoes were never fairly brought to the test of experiment, though he and his friends entertained perfect confidence that they would not be found defective in any of their operations.

minent hazard of being discovered. He immediately made another descent, with a view of making one more trial, but the fast approach of day, which would expose him to the enemy's boats, and render his escape difficult, if not impossible, deterred him; and he concluded that the best generalship would be to commence an immediate retreat.

He now had before him a distance of more than four miles to traverse, but the tide was favourable. At Governor's-Island great danger awaited him, for his compass having got out of order, he was under the necessity of looking out from the top of the machine very frequently to ascertain his course, and at best made a very irregular zigzag track.

The soldiers at Governor's-Island espied the machine, and curiosity drew several hundreds upon the parapet to watch its motions. At last a party came down to the beach, shoved off a barge, and rowed towards it. At that moment sergeant Lee thought he saw his certain destruction, and as a last act of defence, let go the magazine, expecting that they would seize that likewise, and thus all would be blown to atoms together.

Providence however otherwise directed it: the enemy, after approaching within fifty or sixty yards of the machine, and seeing the magazine detached, began to suspect a *yankee trick*, took alarm and returned to the island.

Approaching the city, he soon made a signal, the boats came to him and brought him safe and sound to the shore. The magazine in the mean time had drifted past Governor's-Island into the East river, where it exploded with tremendous violence, throwing large columns of water and pieces of wood that composed it high into the air. Gen. Putnam, with many other officers, stood on the shore spectators of this explosion.

In a few days the American army evacuated New-York, and the machine was taken up the North river. Another attempt was afterwards made by Lee upon a frigate that lay opposite Bloomingdale: his object now was to fasten the magazine to the stern of the ship, close at the water's edge. But while attempting this, the watch discovered him, raised an alarm, and compelled him to abandon his enterprise. He then endeavoured to get under the frigate's bottom, but in this he failed, having descended too deep. This terminated his experiments.

ART. IX. *Remarks on the Revolving Steam Engine of* MOREY, *by* MR. ISAAC DOOLITTLE.

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE, &C.

PARIS, 26*th March*, 1819.

Dear Sir,

PHYSICS and mechanics, especially when relating to American inventions, being my favourite studies, I eagerly seized the new revolving steam engine, invented by Morey, as described in the second number of your Journal; and, although the drawings, and description of its movements are very imperfect, I believe I understand its principles.

The idea is ingenious, but I fear it will prove less useful than brilliant, for reasons which I will endeavour to explain.

And first it may be proper to state, that the intensity or elastic force of the steam is altogether unimportant in the point of view in which I shall consider it; it is indifferent whether it be fifteen pounds or five hundred to the inch area; as I shall only examine what portion of the force applied to give the alternating motion to the piston is actually employed in producing the rotary movement of the cylinder, and what portion is lost to all useful purposes.

The enclosed diagram, Fig. I.* is a vertical section of the machine, (as I understand it from the drawings) perpendicularly to the axes of rotation.

The portion of the force which is employed in producing a rotary movement varies at every instant with the angle of its application, and consequently has a *maximum* and a *minimum*. Its effect also, constantly varies with a perpetually varying lever at the extremity of which it is applied, the effect has therefore also a *maximum* and a *minimum*. These last are the only points at which it would be necessary to examine the machine in order to appreciate its comparative merits; but the points of maximum, depending on the two above causes, are not easily determined without having re-

* The figures referred to by Mr. Doolittle will be found on one of the plates illustrating Mr. Sullivan's Steam Boat.

cource to fluxions, with which I must own I am not sufficiently conversant, and if I were, I should perhaps prefer employing a *mechanical* or graphic solution, because I believe a greater number of persons will be able to understand me. The method I employ, though not mathematically exact, is nevertheless sufficiently so for all practical purposes.

The cylinder in its revolutions describes a circle A. B. A′. B′. Fig. I. about the center c. through which center the piston rod must continually pass, whatever may be the position of the cylinder in the circle; and the point of junction of the pitman with the cross piece of the piston rod, describes, in the same time, the circle x. r. x′. (whose radius is equal to the length of the pitman) about the center o. the distance between the two centers is equal to half the length of the stroke of the piston.

When the cylinder, in its revolution arrives in A. or in A′. the two centres are in a line with its axis, and the whole force employed either to raise or depress the piston, is entirely lost, no part of it being employed to turn the machine —these points, in the common engine, working with a crank and fly wheel, are called the *dead points.* The actuating force is here=o.

If, about the centre c., and with a radius equal to half the stroke of the piston, we describe a circle o. n. n′. (fig. 2 and 3.) and divide the circumference into any number of equal parts, and if we draw lines to represent the piston rod in its several positions, always passing through the centre of this circle, and the divisions of its circumference continuing them when necessary, until they strike the circumference of the circle r. d. f. described by the extremity of the pitman, that point will be the point of junction of the pitman with the piston rod; and a line drawn from the center of the latter circle to that point will represent the position of the pitman.

One half of the circle, (taken in a line with the dead points) being an exact representation of the other half, it is unnecessary to occupy ourselves with a larger portion; if, then we divide the semicircle o. n′. p. into eight equal parts, and find the quantity of force utilized at each of these points, we shall obtain a result sufficiently exact for our purpose.

If we suppose the cylinder arrived in E. (fig. 2.) or in E'. (fig. 3.) and if, from any scale of equal parts, we set off, from the point *a*., on the line representing the piston rod, a distance a. b. equal to two hundred, and consider this as the force constantly applied to drive the piston in the cylinder, this force will resolve itself into two forces ; the one, a. e. parallel to the position of the pitman, which of course is entirely lost, being employed in fruitless endeavours to remove the center piece, the other, a. m. in a line tangent to the circle r. d. f. at the point of contact, a.—by completing the parallelogram a. e. b. m. of which the primitive force a. b. is the diagonal, we have the measure of the forces respectively.

But the force a. m. is oblique to the direction of the movement of the machine, and is therefore again decomposed, the two forces resulting from this second decomposition, act, the one a. t. in a line parallel to the piston rod, and the other a. s. in the direction of the tangent to a circle whose radius is equal to that portion of the piston rod, comprised between its junction with the pitman and the center c. of rotation, and parting from the point of junction ;—By completing the parallelogram a. s. m. t. of which a. m. is the diagonal, the side a. t. parallel to the piston rod, is the measure of the force lost in the second decomposition, and the side a. s. represents the force virtually employed in this point in turning the machine. This force measured by the same scale of equal parts gives sixty-two.

But it will at once be seen that the lever c. a. in fig. 2. is much longer than the lever c. a. in fig. 3. therefore, if the forces were equal, the effects must be different, in inverse proportion to the length of the levers. And, to compare the effect of this machine to that of one working in the ordinary way, we must reduce all the forces to a length of lever equal to that where they could be applied if the cylinder stood still and turned the crank, instead of turning itself around it=this lever is represented by the distance between the centre c of rotation and the circumference of the circle n. o. n'.

To find the equivalent of the force a. s. if applied at the point h. of the lesser circle (fig. 2.) say—force applied at the extremity of long lever c. a. is to length of short lever c. h. as length of long lever c. a. is to force at the extremity of short lever c. h.—in this construction.

$$62:66::125:\frac{66\times125}{62}=133.$$

In figure 3. the force being applied at a lever much shorter than that to which it is to be reduced, its effect at the extremity of the longer lever must be found by inverse proportion—thus—

$$66:62::11:\frac{62\times11}{66}=10\tfrac{1}{3}\text{say}=11.$$

Making similar constructions in the other points of division, and reducing the respective forces to the same length of lever, we have the following series.—

Forces at the points of application.	Forces reduced to an equal lever.
62	133
97	157
124	135
172	52
158	32
176	22
62	11
0	0
Dividing the sum by 8, the number of terms	8 | 542
We have, for the mean force utilized	68 for 200 applied.

In this calculation, as in all which precede, to avoid fractions, where there were any, I have uniformly added an unit in their stead, in order to give the machine "a fair chance."

The mean force 68 is applied tangentially to the reduced circle, whose semi circumference is=207—the force that I have supposed applied is 200, and the stroke of the piston is 131. Therefore force applied is to force utilized ::200 $\times$ 131:68 $\times$ 207 or as 26:14, nearly; then say

$$26:14::100:\frac{14\times100}{26}=54$$

In the common crank the force applied is to the force utilized ::100:78, nearly. Therefore the effect of the new machine, is to the effect of the common crank, with the application of an equal force as 54:78 or ::9:13.

We must observe also, that when the cylinder arrives in B or in B′ (fig. 1.) the piston has performed half its stroke. If, therefore, we consider the pressure of the steam as a weight, and multiply that weight by the distance gone through to find the quantity of force employed in giving motion to the machine, we have force expended in describing the arc B′AB=force employed in describing the arc B, A′, B′.—Therefore, besides the continual variation in the intensity of the force utilized, we find that a much greater portion of the force required for a revolution is spent in describing the semicircle f. A. g. than in describing the semicircle g. A′. f.—and we must not forget that this is the portion of the revolution where the effect is greatest in proportion to the force employed; therefore if the motion of the piston in the cylinder be uniform, the motion of the cylinder in its revolutions must be irregular and *vice versa.*

Add to this, that with the velocity which Mr. Sullivan proposes giving to this machine, the influence of the centrifugal force ought to be taken into consideration—this force also not only varies with the dimensions of the machine and the weight of the piston, but is different at every instant, in the same machine, increasing as the piston recedes from the centre, and diminishing as it approaches; augmenting the effect of the machine in the first instance and diminishing it in the latter; more force is therefore developed in going from A through B to A′, than in going from A′ through B′ to A=another cause of irregularity in its movements, to counteract these effects the machine should be made very heavy, to serve as a fly wheel.

I have hitherto considered this engine without reference to its friction; this, in certain points of its revolution, must be immensely greater than in the old engine, as will appear evident to the most superficial observer, on a simple inspection of its construction.

These are some of the imperfections which this engine possesses in addition to all those of the common one, and I can discover nothing in its favour but *novelty.*

There is no doubt but it will turn, if it be not too much loaded, and its movements will probably produce an agreeable effect, but I do not apprehend that Oliver Evans has any thing to fear from its rivality.

You are at liberty to make what use you please of this communication.

I am, sir, very respectfully,
Your obedt. servt.

I. DOOLITTLE.

Art. X. Mr. Sullivan *on the Revolving Engine; in reply to* Mr. Doolittle.*

TO PROFESSOR SILLIMAN.

Sir,

I WAS so well aware of the inadequacy of my description of Morey's Steam Engine in your second number, that I had already thought of offering a supplement, when you gave me an opportunity of reading the remarks of Mr. Doolittle, which I presume you will insert, preceding this further explanation.

The invention was then quite in its infancy, and your American readers will require no apology for occupying a page of your Journal once more, with a subject perhaps interesting only as it relates to the developement of the resources of our country: this form of the engine being peculiarly adapted to canals and other inland navigation.

Referring to the annexed plate and explanation, I will briefly attempt to answer the remarks of your correspondent.

The objection that a part of the force is lost in producing a rotary motion, applies, I think with equal propriety to all engines communicating by the intervention of the crank —as in all of them it must be considered as a varying lever. By *loss of force* must be meant the difference between the effect it would produce were its action always at right angles to the crank, and its indirect action, as it revolves.

Professor Playfair estimates this difference as 7 to 11—that is, a rotary motion is produced by the crank at the expense of $\frac{4}{11}$ths of the power which the engine would have, could it be exerted directly upon its object, or load. This estimate of loss relates to atmospheric engines.

Notwithstanding this however, it was considered a great improvement when Mr. Watt introduced the crank. It gave the steam engine to many more useful purposes; though

* *Remark.*—The temporary suspension of the Journal offered me an opportunity of submitting Mr Doolittle's remarks to Mr. Sullivan's perusal, which gives these gentlemen the mutual advantage of having their pieces appear together, instead of coming out in different numbers.—Editor.

some part of the force, was undoubtedly lost at every stroke, in giving motion to the balance wheel necessary to equalize the movement. Whether the loss of force by a crank is actual or theoretical, may be a question. It is not one however which applies to this engine so much as to others, because it is moved by very elastic steam always operating in one or both of the two cylinders which compose this engine.

Your correspondent deems this unimportant to the question he raises,—which I may answer more satisfactorily to your readers, by a quotation in point, from Dr. Young's Lectures. He is speaking of the use of the crank before mentioned, as an improvement in the Steam Engine.

"If the rotary motion of the Crank be equable, the progressive motion of the rod will be gradually accelerated and retarded, and for a considerable space of the revolution the force exerted will be nearly uniform; but if we attempt to communicate at once to the rod its whole velocity in each direction, as has sometimes been done, the motion would become extremely irregular, and the machinery would be destroyed by the strain.

"On the other hand it must be observed, that force applied to the machinery, may in general be divided into two forces; the one employed in opposing the force, so as to produce an equilibrium only, and the other in generating momentum.

"With respect to the first portion, a *single* crank has the inconvenience of changing continually the mechanical advantage of the machine; with respect to the second, its motion in the second quarter of its revolution is accelerated, instead of being retarded by the inertia, which this portion of the force is intended to overcome; and from the combination of these causes, the motion must necessarily be rendered very irregular.

"☞This may however be completely removed by employing always *cranks in pairs*, one of them being fixed so as to make a right angle with the other."

Here Dr. Young does not seem to think this supposable decision of force "lost to all useful purposes," but incident to the nature of machinery—or remediable on the same principle by which steam, as a power, is applied by the double revolving engine. Whatever deduction is to be made then from the original power, arises from the friction of the machine only—which point we will consider after a moment's attention to the nature of force.

Force is known and measured only by its effects.

If a machine is so constructed as to render gravitation, atmospheric pressure, or the expansion of elastic fluids, operative, continually; then the machine will be more or less perfect, as it consumes on itself, the power from these sources, in transmitting it to its object.

But as in estimating these sources of power, *time* is a necessary circumstance; the constant transmission of the power by the machine, will enter into the estimate of its quality. And if, as in the common steam engine, the atmospheric pressure is not constant, or if being so, the manner of conveying it is not constantly the same, it may be said to be a loss of power only because it is a loss of *time*, in which, were the machine otherwise constructed, the power might have been exerted.

Your correspondent misleads the mind by the terms in which he states, that "he proposes to examine what portion of the force applied to give the alternating motion of the piston is actually employed in producing the rotary movement of the cylinder, and what portion *is lost to all useful purposes*."

And he thinks, "when the piston is in a line with the two centres," (or is proped for the moment, by the fixed crank) "that the whole force employed to raise or depress the piston is *entirely lost*."

We have anticipated the first point by reference to Young;—and need only add, that it is unnecessary to investigate what is an already received and established rule, that the difference of advantage between a force acting constantly at right angles with the crank—and obliquely at a varying angle as usual, is as 7 to 11.

As to the second, it may be said there could be no power in question, but through the intervention of the machine, and if the operation of the machine is suspended in the position supposed, there can be no power to loose—but your correspondent carries his idea of the practical effect of the principle of resolution of forces to an extent, that militates with some received principles of mechanics. He assumes as a given quantity 200. "This force will resolve itself (equally) into two forces; the one parallel to the position of the pitman, which of course is entirely lost, being employed in fruitless endeavours to remove the centre piece."

When two forces meet at an angle, they produce a third, nearly equal to both in the diagonal of a parallelogram, produced from the two lines of their direction—and yet scarcely any thing is lost.

We know too from the highest authority, "that if any body draws or presses another, it is itself as much drawn or pressed:" that "all forces act reciprocally," that "action and reaction are equal"—but it is not thence concluded in theory—and surely it would be contrary to practice to say, that any of the force is lost.

When a boat is moved by oars, the force exerted on the extremity of the oar, reacts upon the boat.—

When a lever is applied to raise a weight, the whole force reacts from the fulcrum.—

When a gun is fired, the elastic air acts on the bottom and sides of the chamber, which do not consume the force, but react upon the ball.

And in like manner the force derived from the steam (in this case) is returned from the fixed centre piece, as a basis, and through the intervention of the pitman gives revolution to the engine.

An unqualified objection is made to this engine, on the score of friction. It is said, "the friction of this engine will appear evident to the most superficial observer, to be *immensely* greater than in the old engine."

This manner of expression and of judgment appears to be equally unphilosophical. It supposes the friction of a machine greater, as it may seem to such an observer complicate. It seems to leave out of the question the established law of mechanics, that "friction is simply proportional to the weight or pressure, that brings the substances concerned into contact, independently of the magnitude of their forces,—and that friction is a uniformly retarding force."

On these principles an engine of equal power, that is not more than a third as heavy as others, must have the advantage of this difference in point of friction, the work and adjustment being equally perfect. It cannot be denied that a good adaptation of parts, makes a great difference in machines, and that oleaginous substances interposed lessen the friction essentially. All these things being equal, the law above stated applies, nor is there any particular portion in which it is peculiarly great. The most disadvantageous moment is, when the piston has reached the end of the stroke, and starts in the other direction: but it starts gently, and when in the other cylinder, the power to help it, is greatest—the substances in contact are a polished surface of iron and oiled hempen packing; there cannot be much attrition between these; every other part of the engine is lubricated, and moves always the same way.

The Rotary Valves seem the most subject to this objection at first view. Here are two surfaces moving upon each other, one of iron the other of brass, both perfectly polished, and occasionally oiled; they are kept together by springs, elastic enough to preserve the contact; for the *tendency is to separate;* there is little or no weight or pressure to cause friction between them and it cannot possibly be great.

You have witnessed the operation of a large engine of this kind; and must recollect with how little force of steam it moved.

I believe nothing in mechanics is more difficult to estimate than friction, what is ever incident to machinery; but it should not be confounded with the obstacles to be overcome in the imperfections of work as well as of plan.

Its unavoidable existence however, shews the expediency of reducing the steam engine to as light a construction as possible, as well as to get rid of those massive members which waste the original power on their own movements.

Experience is our surest guide in mechanics, and perhaps the late Mr. Evans' heirs may have nothing to fear from what Mr. Doolittle calls the rivality of Morey's invention. But I can assure him of the fact, that the same boilers which once carried a twenty horse engine of Evans' in my first steam tow-boat, that could not be made to tow more than one boat, now applied to a small *single* revolving engine, can tow four boats faster than that one was carried and consume not half so much fuel.

Dr. Young justly observes that the beauty of a contrivance, and the skill of the contriver depend, principally, on the simplicity of the means, and the safety, and durability of the machine. Mr. Morey, who was one of the earliest experimentalists of our country, in Steam Boats, deserves the praise this implies. I prefer his engine to carry on the inland navigation in which I am concerned. Should a better engine be devised it will become my interest to adopt it. At present I am perfectly satisfied.

But it may be useful to shew what reason I have to be so, and why this engine is preferable in navigation.

It will be recollected that it has long been a desideratum to give the steam engine a rotary movement. I do not know that it has heretofore been done in a form or manner sufficiently free from objection.

The combination however, of two cylinders at right angles, has the same effect. They produce a continuity of the power, whatever that is; and enable the engine to work with equable motion, without a balance wheel, objectionable in navigation on account of its weight, as well as cost.

We are enabled by this form of the engine to give the power of steam to canal navigation, and shallow inland waters; to apply the power directly to the axis of the water wheel of the boat which is thus made the connecting axis of the engine. No form of the Steam Boat can be more simple.

The boats for this purpose have a peculiar form, which gives a recess or chamber at the stern, for the play of the wheel, or crank paddles of a peculiar construction, so that nothing encumbers the sides.

The boilers when the boat is large, stand on or above the deck, covered from the air and weather. The whole body of the vessel being unincumbered and free for the use of loading or of passengers.

An important saving of expense may be made in consequence of the reduced size of the machine; for its complete adaptation to the use of high steam admits of a great power, thus exerted in a small compass. Expense is also saved in the manner of attaching the engine to the boat or vessel, so as not to depend on the stiffness or firmness of the bottom; the center of reaction being the centre of the engine.

When this kind of engine shall be applied to steam batteries, it will be found capable of propelling them perhaps with more than usual velocity, and at much less expense:

but its great utility will be found in facilitating water carriage on those rivers, which are at times shallow, and those which are rendered more extensively navigable by canals around their falls.

I am, very respectfully, yours, &c.

J. L. SULLIVAN.

Boston, October, 1819.

P. S. In the Hartford Boat, we used the Tar or Gas fire with good effect : but I am not able to state yet, precisely the proportion of saving. The men about the engine however, thought it equal to as much again wood as they used.

When I have made some decisive trials I shall communicate the result.

Remark. We understand that Mr. Sullivan and Mr. Morey have in the investigation of the economy of the liquid fuel of steam engines, (or tar and steam fire,) made some discoveries and improvements which bid fair to be very useful and economical. They are in practice in a steam engine which carries the recently invented self directing lathe, which makes ships'-blocks, lasts and other irregularly formed articles.

Explanation of the plates referred to in the preceding communication.

Index to the annexed plate of the Revolving Steam Engine.

a a a Boilers,
b b Cylinders,
c c Counterpoise, (not absolutely necessary as the cylinders counterpoise each other.)
d d Frames holding the cylinders, &c.
e e Axes on which the frames rotate,
f f Fixed cranks or centers,
g g The pitman or bar,
h h Cross pieces,
i i The Piston rods,
k k The Ribs which preserve the parallel movement of the rods,
l l The rotary valves,
m m The fixed counterpart to the rotary valve,

n n The springs which keep the valves together,
o o The Throttle valve box and pipes leading steam to the cylinders,
p p Pipes leading from the cylinders,
r r The intermediate shaft,
s The clutch box, to connect the shaft and wheel,
t The clutch box lever,
u u Cog wheels communicating motion—the reverse of this proportion is found in experience preferable,
w w The main shaft,
x x The safety valves,
z z The gear and crank for the supply pump.

Fig. 2. The inside or face of the valves shewing the grooves,
3. The cross pipes and double passage cocks to produce the back motion,
4. Wheels with moveable floats,
5. The gas fire apparatus and pipes—not placed in this instance to the best advantage. The vessel should be placed on its head.
6. Profile of a Boat the boilers above deck, (see note b.)
7. The stern view of the revolving engine applied to the axis, cranks and stern propellers,
8. Outline of the apparatus attached to the stern,
10. Profile of the stern with paddles.

Note a. By proportioning the revolutions of the engine to the motion of the paddles or wheels so that the engine will ordinarily move moderately and the wheels fast; we are able when the vessel has speed, either from the wind or steam, to superadd the power of this engine to her acquired momentum, so that the maximum of effect may be attained. If the engine has power to go too fast for the paddles they may be made to take more hold of the water—and the reverse.

Note b. It being desirable that boilers should be placed as much a-part from the loading and passengers as possible, the recently invented fuel will permit of arrangements very favourable to the economy of room.

Note c. The advantages of a double engine are perhaps very important in boats of the largest class, but a single engine applied to the stern propellers, is the most simple and lightest form of the engine; and is best adapted to those rivers of our country which flow through alluvial land, and consequently make their channels alternately close in with one shore or the other, as their winding course directs the force of the current. A steam boat therefore which has no external wheels or apparatus, will be less exposed to accidents from the shore, the trees upon it, or from drift wood.

FOR THE AMERICAN JOURNAL OF SCIENCE.

Art. XI. *Observations on the Dry Rot, by* Col. George Gibbs.

THE late extraordinary decay of Timber, by a disease, termed the dry rot, in the commercial and military marine in Europe, has excited much attention, and called forth many schemes for prevention or cure. But I have not been fortunate enough to meet with any account of its cause, or any proposal for a remedy, which could satisfy me, still less the Gentlemen skilled in naval affairs.

It appears, that this disease affects wood, whether dry or moist, though more in the latter case : that it has become more common within thirty years, and since that time large ships have been discovered to be entirely rotten on the stocks, before the preparations were made for launching them.

Steaming the Timber has been tried in America, and found injurious; oil and paint are ruinous; and many other operations have been recommended, some of which were found injurious, others ineffectual, others too costly for trial. All the ingenuity of the English mechanics seems to have been employed in scheeming and failing; much money, and some lives, have been lost in these experiments.

The Dry Rot has been ascribed to the use of green timber, or wood not sufficiently seasoned or docked; but, though docking timber is, to a considerable extent, important, yet it is found that this remedy is by no means sure, as ships with which this precaution, as formerly, has been tried, have been found at times subject to the dry rot; so that in spite of every care, large vessels in Europe do not last half as long as formerly.

In the United States this disease is by no means as common, although it gradually becomes more so. Our merchant ships are at times troubled with it. Our ships of war being built of live oak, cedar, and locust, are less exposed to this evil. The live oak appears to be almost indistructible, except perhaps by its contact with other species of wood, the juices of which, as in treenails,* may injure it.—But the time is not far distant, when we must bewail this calamity, or discover some preventive.

The same evil attends the construction of modern built houses. The timbers of the roof of Westminster-Hall have been in place six hundred years, and I have examined in this country some which were placed one hundred and fifty years ago, and are seemingly uncorrupted and incorruptible. But no architect now would calculate on a durability of half the latter term. I have been informed that some of the floors in the new City-Hall, in New-York, though finished within only six years, have been removed on account of the dry rot.

Considering these and other facts before the public, I have been led to believe, that the dry rot is owing to the nature of the wood, rather than to the deficiency of ordinary preparation.

The wood of a tree consists of the heart and the alburnum, or sap wood which forms the external concentric Layers. This last is the vehicle of the sap. In young trees, it extends to the centre, but as the tree grows, the heart becomes firm, and ceases to circulate the sap, and this process continues during the life of the tree. In aged trees the sap wood forms only a small part of the timber, till at length a process similar to ossification in the old age of animals takes place, and the tree dies for want of nourishment.

The durability of heart, and the pernicious effects of sap wood, are well known ; but as timber bears a high price, workmen content themselves with taking off the coloured sap wood, without regarding the remaining part in the timber. An oak tree, at the age of eighty years, is generally of a size fitted for timber for large vessels. But if we compare this tree to one of the same size, but two hundred years old, we shall find the real proportion of sap wood and heart very different in the two specimens. Now if we con-

* Trunnels? so pronounced by the ship carpenters.—*Editor.*

sider the enormous consumption of wood during the last century, in large and small vessels, in houses, and in all the objects which add to the comforts of society, both in Europe and America, we may justly suppose that few old oaks can be supplied in Europe, and that the number in America is continually diminishing.

We are therefore justified in believing, that the dry rot in vessels and houses, in its present extension, is owing to the use of young timber, to which architects have had recource, in consequence of the destruction of the old forests. It is perhaps impossible to prevent the danger, but it may be in our power to guard in a great measure against it.—And it is of so much importance, that I feel less reluctance in offering my opinion on the subject.

The object of every process for the preservation of timber, must be to extract the water of the sap, and to destroy the absorbent power of the wood, and chiefly of the sap vessels. The different uses for which the timber is intended, will of course cause some difference in the mode of its treatment. For this purpose, I suggest with diffidence the following processes, some one of which may probably be used in every situation:—

The first method is suggested by a very common usage of charring posts which are to be placed in the ground.—This method is of very ancient date, it having been used both by the Grecians and the Romans; and the piles so used either for bridges or foundations of temples, are now frequently found in a state of complete preservation, after a lapse of two thousand years. But the use of this method must necessarily be very limited.

Another method may perhaps be tried with success, and without greater expense than many that have been resorted to without avail: I mean the use of smoke. This would evaporate the water of the sap, and carbonise in some measure the wood.

A third method is the application of lime, either in solution or as air slacked. The first would act like the muriate of soda in sea water, in the docking of timber, but from chemical affinity, much more powerfully. It might be applied to timber in most situations. I understand that when the steam frigate was built in New-York, a quantity of potash was poured into the centre of each timber. [Between contiguous timbers? *Ed.*] But it is the surface, and not the heart of the wood which first decays. This alkali, like lime, could not fail of being useful when properly applied. Air slacked lime, filled in between the timbers, would keep a continual action on the neighboring wood, until the sap was extracted, and the wood in all its parts completely penetrated by lime. This, with the occasional use of a solution of lime, would render the wood incorruptible, as well as incombustible, and the woody fibre, like the animal fibre in leather, being saturated, would increase in strength and durability.

G. GIBBS.

Sunswick, August, 1819.

P. S.—Since the above was written, I have received from Col. Perkins, of Boston, some valuable information on the subject, which I will briefly state:—Several ships built at that port have been salted, or filled in between the timbers with salt whilst on the stocks, and after a lapse of ten or fifteen years the timbers have in every case, been found to be perfectly sound. A large ship belonging to him, which had been salted, (fourteen years old) required repairs, new decks, and new iron work. Considering the age of the ship, it was important to examine the frame in every part. The ceiling was therefore ripped up, and a complete examination took place. The result was, that the timber and plank were found completely sound in every part.

I accompanied this gentleman on board of a salted ship belonging to him, and now in this port. The timbers were not so close as usual in frames of vessels, and the salt was retained at different heights by wedges between the timbers, so that the salt in settling should not leave any considerable height vacant. It took five hundred bushels of salt for this ship, of five hundred tons; and two years after being built, one hundred bushels were added to fill up the space of the salt dissolved.

Another instance has been communicated to me by an intelligent officer of the Navy. The Argus U. S. brig was built at Boston in 1802, of green timber, was salted as above, repaired at the Navy-yard in New-York in 1814, and the timbers found to be perfectly sound.

I see no objection to this treatment, except from the great weight above, say 28 tons in a ship of 300. The expense is not material, but the iron work I should think would require renewing oftener than in the other modes. Whether a dampness would be created injurious to the health of the crew of a large ship of war, to its provisions and amunition, or to the freight of valuable goods, requires further experience.

G. GIBBS.

ART. XII. *On Heat and Light; by* MR. SAMUEL MOREY* *of Orford, New-Hampshire.*

[First Communication.]

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE, &c.

Sir,

IF in the following experiments on light and heat, with remarks on the economy of burning water as an object of fuel, any thing can be found worthy of a place in your valuable Journal, it will be perhaps more than I could reasonably expect.

Yours respectfully,

S. M.

Water, it is well known, is composed of some of the best materials for producing light and heat; but when formed by combustion, something which those materials did contain appears to be parted with, or is neutralized, which must be restored to render them again combustible.

How shall that be effected, so as to render the process easy and useful?

* I presume that no apology will be necessary for giving Mr. Morey's valuable communications entire. They are the practical results of an ingenious practical man who as he ingenuously states, " having no pretensions to science, no chemical or philosophical apparatus and little or no access to men of science, has spent much of his life in experiments." Such results are often very valuable, and perhaps, in some cases, not the less so, for having been sought without the direction of preconceived, theoretical views.—*Editor.*

Electricity will restore it—May not the same or other materials, which furnish that electricity, at so very low a temperature, furnish it directly to the water, at a higher, though convenient one ?

If water, in considerable quantities is thrown on oil or tar in a state of inflammation, the flame is greatly increased, which evidently arises from some effect which the oil has, in preparing the water for combustion.

If oil will, at or near the temperature at which it boils or takes fire, produce the same effect, we have only to pass the steam of boiling water, through oil at that temperature, to furnish a regular supply of fuel from the water—and, if only the Hydrogen is in the first instance given out for use, the Oxygen by mixing or combining with the oil, will undoubtedly render it a drying oil, and more combustible, and ultimately assist in making the combustion the more perfect.

Many experiments seem to justify these conclusions, some of which will be mentioned.

If ever so small a drop of water, fall into oil at a temperature near boiling, it evidently is decomposed, for the explosive report is sharper than that of gun powder.

If tar, containing a considerable proportion of water, is dropped on brick or metal; at a temperature which will rapidly evaporate them, the vapours burn with white shooting streaks, much flame, and without smoke, while the water lasts. Inflamed drops of tar, burn, while falling, with a red flame and much smoke, but on reaching boiling water the smoke instantly disappears, and streaks of a white flame shoot up.

If water in one cylinder be made to boil, and the steam be led to the bottom of another, containing rosin or tar, at a high temperature ; after passing up through it, the water together with the vaporized portion of the rosin or tar, will, when the proportions are properly regulated, burn with an intense white flame and no smoke, much the greater part of which, appears (by alternately shutting the steam out, or letting it in,) to be derived from the water.

So also if steam be led over the surface of tar in a cylinder, and made to force out a small stream of it, through a pipe, into which a quantity of steam is also admitted, and made to mix intimately with it, they burn with a great body of flame and intense heat, and without smoke provided the proportions are well regulated.

Again, if water in one cylinder be made to boil, and the steam be led to the bottom of another included cylinder, containing spirits of turpentine, the steam, when let out under a moderate pressure, carries off with it a sufficient quantity of the spirit to burn with a pleasant white flame, free from smoke; by increasing the pressure, the flame will become in part or wholly blue. Here as in many other experiments, I have noticed, that different coloured flames may be produced from the same materials—are the products of the combustion different?

If the steam of water, containing a small proportion of the vapour of rosin be driven against iron, at or below a red heat, it burns with a pleasant blue flame, which will be extended some way back into the column of the vapour, intermixed with innumerable sparks of very white flame, evidently particles of the rosin.

If the vapours, when the proportion of rosin is very small, are made to pass between two plates of iron, at or near a red heat, they can be inflamed on the opposite sides of the plates, and will then, sometimes, burn with an entirely blue flame, although the vapour cannot be inflamed, without the intervention of the plates.

If the steam of boiling water, be led to the bottom and passed up through tallow at a high temperature, and then through cold water to condense the vapour, the hardened tallow will float on the surface: and on applying a flame, it would sometimes, take fire, some distance before the flame reached it, at other times it would require, to be in contact a few seconds, always beginning to burn with a blue flame, and after the whole surface had been sometime enveloped in flame, and the heat was such, against one side of the top or rim of the vessel, as to cause the water below the oil on that side to boil, and pass up through the oil, the flame on this side would be chiefly blue. Does not this show that the steam was on this side decomposed in passing through the inflamed tallow, and from its sometimes taking fire on the approach of a flame, it would appear clearly that there was an evaporation of hydrogen, from the tallow, and when burnt with the same sized wick, it appeared to me to give three or four times as much light as other tallow, which pointed out as I thought, that it was rendered in the process highly combustible.

If a given quantity of strongly compressed boiling water be suddenly discharged into about an equal quantity of oil or rosin, at or near the boiling point, they explode to every appearance as quickly and violently as gun powder, and would without doubt, be as fatal. In this case, an immense quantity of highly inflammable gas or vapor is formed in an instant, and apparently without any aid from caloric.—[Except what is contained in the materials?—*Ed.*]

When sulphuric acid is mixed with water, it is well known that much heat is given out. If after standing until the mixture becomes cold, iron filings are then added, much hydrogen gas will continue to be formed for a long time, and much sensible heat will be again given out. We must here look, certainly to some other cause, besides the caloric given out by the oxygen, in passing from a liquid to a solid state. If a small quantity of spirits of turpentine be added, it burns with a very pleasant white flame, and without smoke. Here again it is very evident the greater part of the bulk of the flame is furnished from the water, which in this case, is again directly reprepared for combustion, without the least expence of caloric.

At present sir, I will not trouble you with an account of any more experiments in which I have thought that water was, and might be useful in producing light and heat; I will only add one or two more, in which it is not concerned.

If to tallow or linseed oil a small quantity of salt-petre be added, and the temperature raised to nearly that of the boiling point, the salt petre appears to be dissolved and held in solution by the oil; they will evaporate together, and the mixture, or the vapour, will burn, wholly excluded from the atmosphere. If science will point out a mode of retaining the mixture when cold, I have thought perhaps it might be more extensively useful than the safety *lamp*.

If the vapor of spirits of turpentine be made to pass through a tube, covered at the upper end with fine wire gauze, it burns with much smoke; if a quantity of atmospheric air be allowed to mix with it, the smoke ceases, but the flame continues white. If more still be added, the flame lessens and becomes partly blue. By adding still more and more, it will burn with a very small flame, entirely blue, and with a singular musical sound. If still more be added, the flame and every ray of light ceases, but that the combustion still continues, is certain, from the explosive detonating noise or report, continuing to be distinctly heard.

Orford, May 4th, 1819.

Art. XIII. *On Heat and Light; by* Mr. Samuel Morey.

[Second Communication.]

TO PROFESSOR SILLIMAN.

Sir,

As the use of a certain proportion of water for affording heat and light, has become more familiar, and some of the experiments being very simple, and such as may be easily repeated, I have thought I might be justified in submitting to your perusal some further remarks and experiments on that subject; hoping you may there from select something which may find a place in the American Journal.

I find, that, for common use, the most convenient mode is to evaporate the substance designed to afford light, or light and heat, provided it naturally contains a sufficiency of water to make the vapor burn with a white flame free from smoke; or if not to furnish the supply by a small separate boiler:—depending on the decomposition of the water in burning the vapor, to free it from smoke, as well as to increase the intensity of the light. This mode of furnishing light and heat for common uses, has many advantages, it appears to me, over that of forming and burning gas, some of which will be hereafter mentioned.

If we observe mineral coal when the fire first reaches it, we shall perceive, that the vapor which first issues, burns with a white flame, free from smoke; owing undoubtedly to the great proportion of water. So also it is with pitch-pine wood, or the fat knots, if the heat be not too great. It is curious to observe the effect in burning any kind of pine wood, which contains more or less of these knots. The streams of vapor are often pushed out to a considerable distance, and burn with a very pleasant white flame. These knots burn for a long time, and will sometimes retain water enough to burn the vapor without smoke, until the whole of the wood adjoining them has been converted into coal.—These streams of vapor appear to me to be very different from those of the Carburetted Hydrogen, which are often seen issuing from burning wood after it has become nearly coal. These rarely, if ever, go out, and the flame follows them to the wood. Not so with those of the vapor : they are plainly to be seen issuing to some distance, and mixing generally with a proportion of air, before they will burn; and they are often extinguished by puffs of too great a proportion of steam. The colour of these vapors, their detonating noise, their variously coloured flames—(blue, blue and white, white and intense white) we can now perfectly imitate at our pleasure with the patent lamp stove, by burning tar, pitch pine, or mineral coal and water.

One of the greatest difficulties which I have met with, was from the inclination the tar or rosin manifests, to overflow or run out, when heated to about the temperature of boiling water; this disposition arises undoubtedly from the sudden conversion of the water, contained in every part of the tar, into steam. The best mode I have tried of obviating the difficulty is, by filling the vessel only in part—say one quarter with tar, and then filling it with small or fine coal.* The effect appears to be, that the tar, as it becomes heated at the sides of the vessels, rises up and passes off laterally into the centre of the coal, in a geat measure out of the reach of the high temperature at the sides; when the bubbles are broken, the vapor passes up through the coal, and the tar settles down, to repeat the same operation. This experiment may in some measure be easily tried by a common skillet. Fill it about one quarter with tar; place live coals around it, and in a few minutes the tar will flow over : but, if previously fine coal be added so as nearly to fill the skillet, it cannot be made to flow over with a common charcoal fire, unless urged by a strong blast. When the vapor rises pretty freely above the coal, and if a flame is applied, it takes fire and will continue to burn while the tar lasts.—If a piece of coal of some size be made a little concave and placed at the top in the centre, and a little water poured into it, it remains a considerable time, although enveloped in flame : and is evaporated without boiling. The flame around this

* We take it for granted that charcoal is intended.—*Editor.*

water, while evaporating, is whiter and freer from smoke. If a tunnel be inverted over the coal, the vapor as it issues from it may be inflamed. At first, in consequence undoubtedly of the great proportion of water given off by the tar and coal, it burns without smoke. When the flame becomes reddish, and there is much smoke, pour a little water into the tunnel as it stands; it is received on the coal without driving out or exploding the tar, as it otherwise would. The vapor may again be inflamed, and again burns without smoke. Much in this way, may be had a useful light and fire for cooking especially at sea, and for a great many other purposes. If the tunnel be flatted, or if the coal has been partially saturated with water, it burns with less smoke, and sand or ashes will prevent a loss by the side. Another great advantage derived from the coal, besides that of giving a more uniform steady fire, and preventing the tar's running over, is the great quantity of water it absorbs, and that of the water's adhering so obstinately to it, which in a great measure, answers every purpose of a constant supply of steam from a separate boiler. Newly made and red hot charcoal will take up about three times its weight of water, which it will in some measure retain until nearly consumed.

Sand, ashes, or fine clay answers well for mixing with the tar &c. If the latter be made into a paste with equal parts of spirits of turpentine and water, and cold lumps of it of a conical form be placed on a table, and a flame applied, the vapors burn without smoke for a short time; if placed on a stove at a temperature something like that of boiling water, the flame continues much longer. If enclosed in a tin cylinder, and the vapor be made to issue through small holes at the top, placed as before stated, or on a plate over a chafing-dish of coals, it burns with a very white light, free from smoke. If the cylinder be tight at the top, and the vapor be led from the inside at the top, down and through the bottom and there be made to issue in an oblique direction, and from a number of small openings, it will burn with a beautiful flame, and supports and regulates, very accurately, its own evaporation. The oblique direction carries the heat in part beyond the cylinder, when the evaporation is too great.

Every effect may be produced in consuming the smoke, and giving an intense white flame, by using a certain proportion of water intimately blended or mixed with these vapors, that can be from an excess of oxygen furnished by creating a very strong current of air, with a high flue. With water it is effected much more conveniently, and without carrying off any part of the heat from the room. Another advantage is, it carries along with it the whole of the tar and consumes it. For instance, if into a piece of a gunbarrel about six inches long, tar be made to flow regularly at one end, a quantity of steam let into the same end, and the iron kept at a temperature below or at a red heat, the vapors issuing through small holes at the other end, may be inflamed, and, if the proportions are right, will burn without smoke, and for aught that appears, may be continued while the supply lasts. But if the steam be shut off, and the tar contains no water, the small apertures and the barrel itself will in a short time, become filled with a coaly residium.

Another advantage in using a proportion of water is, that tar or rosin is evaporated at a much lower temperature, which must be increased as the proportion of water decreases, in order to furnish the same quantity of light.

As I understand it, all the heat that is necessary to furnish the vapors of these substances, is a sufficiency to volatilize them: and this temperature must be nearly preserved, to prevent their condensing, until they issue through the apertures to be inflamed. A red heat is never necessary. The stove, or lampstove mentioned, and which I use, is so constructed, that after being once filled, it will supply the fire regularly and constantly for any defined length of time, without any further attention. For instance—if a cylinder of sheet-iron, say two feet long, four inches in diameter at top, and about five at the bottom, having a grate one or two inches from the bottom, be filled with charcoal; an aperture being made one or two inches above the grate, the coal, ignited at the bottom, (the top being covered,) will burn only at the bottom, whether the air be led directly across the coal and taken from the opposite side, or made to pass down through the grate, and led away from the bottom. Nor does it make any difference, whether the air let in below or at the grate, passes up through the coal, and is let out at the top; the quantity being regulated by a register, from a well known principle, it can burn only at the bottom. As the coal consumes then, it settles down, and furnishes a constant and almost perfectly regular supply; so much so, that while evaporating the pitch pine or other substances for the light, it is hardly possible sometimes to perceive any variation for hours.

The cylinder for holding the pitch pine or other substance, is placed within or surrounds this. I find the best mode of letting out the vapor, is from a circular tube, on the principle of Argand's lamp; sometimes, when much light is required, from a cluster of them; and to furnish them with fresh, and very hot air, by a tube passing down and through the ignited coal and grate. This very hot air tends much to preserve the temperature of the vapor until inflamed; and to increase the bulk of the flame, as well as its intensity. This tube requires a register also. And this kind of lamp, or lamp-stove, admits of a glass burner or flue, as conveniently as any other.

It will easily be seen, that thin sheet-iron on this plan, will give as regular and as durable a heat, as brick or stone of any thickness. If instead of putting in ignited coals at the bottom, two or three inches of them are placed on the top, the red heat of the coal passes down through the whole in a few minutes, leaving the coal black above, just as fast as it is ignited below, until it reaches the bottom, when it becomes stationary. After this process, there is no smoke from the coal, even if there was before.

We can burn in this kind of stove or lamp, (which may be at the same time, for aught I see, extended to warming and cooking, as well as to the lighting of houses, manufactories, &c.) charcoal partially saturated with water or not; or the steam may be furnished by a small tin plate, or other boiler, receiving its heat from the stove, and directing the steam to or near the bottom of the tar, &c.: tar, rosin, rough turpentine, or the spirit, or alcohol, or any kind of oil, fat, or tallow; mineral coal, pitch-pine wood, and the knots, birch bark, pumpkin, sun-flower, flax, and other seeds; as well as many other substances: the result is, a pleasant or intense white flame, free from smoke. That substance which nature has the most generally distributed over the earth, and which too is the cheapest known or used for affording light, appears to be the best adapted for burning in these lamps: for it is equally safe, easiest managed, evaporates at a lower temperature, consumes a greater proportion of water in its combustion, contains the water within itself, and gives a brighter light than common candles or lamps, and without smoke or smell.—It is pitch pine wood.

What this highly inflammable substance contained in this wood is, I know not; undoubtedly it is well known to others. But it is certainly a very different one from the tar obtained from the same wood. The more volatile parts are evaporated at a temperature below that of boiling water, and burn well with three parts of the vapor of water: the flame then, however, is nearly blue. A kind of spirit may easily be procured from distilling this wood, which will be highly inflammable; and which, I should think, can cost but a few cents per gallon, as it comes over most rapidly. It is with all its water well calculated to burn in these lamps.

I exposed some of it to severe frost one night, and found nearly three-fourths of the lower part converted into a cake of ice. This was some of the first that came over, and consequently contained more water than it would afterwards. It was distilled by one of the lamp-stoves, exactly in the same manner as if I had filled it for burning to give light. While distilling I often applied a flame to the vapor, and found it always would take fire. Its appearance is very similar to brandy. One pound of the fattest part of the wood gives from eight to twelve or fourteen ounces of the liquor or spirit. It dissolves rosin, mixes and spreads well with paints, and appears to prepare wood as well for receiving a coat of paint as oil.

There is something singular in the vapor of pitch pine, when issuing through small apertures. The particles do not repel each other like other vapors; but, if not inflamed, they issue, when under a moderate pressure, two or three inches without increasing their size at all: sometimes these jets extend eight or ten inches and apparently as fine as a hair, accompanied often, above the stream, with an invisible vapor, which is known only by its burning with a blue flame, hardly visible. There is no doubt that on a scale of some magnitude this substance will afford abundance of heat for its own evaporation, much in the same manner as that mentioned for burning spirits of turpentine and water. The birch bark too is almost wholly converted into a liquid, darker and thicker :* and as the bark of this wood appears to be as indestructible by time as charcoal, I know not why this too may not be useful for many purposes. Nothing can burn better than the vapor of this bark, but it requires a much higher temperature to evaporate it; and as it is replenished by nature when taken from growing trees, by cultivating those trees for firewood, we at the same time are reaping an abundance of an excellent substance for light.

When the piece of gun barrel mentioned is used, it makes the chief of the grate, the flame and the smoke, when there is any, and the air also, enter about two inches above and pass down through the grate. The bulk of the flame, when the steam is suffered to flow in, is nearly as three to one, and much whiter. A singular circumstance often attended this mode of proceeding, when it was employed in burning rosin and water. Instead of ashes I found potash only, or little else. So much was this the fact, that with a particular kind of coal, the grate would become, in about two hours, so choaked or coated, as obliged me to remove the fire.

I give the result, (very nearly,) of experiments made on the evenings of the 22d, 23d, and 24th of March, with a lamp weighing two pounds and two ounces, the inner cylinder of which is of two inches diameter at the top, and about two and a quarter at the bottom, and six long, besides about one inch tunnelled out at the bottom of the outer cylinder, which is seven and a half inches long, leaving a space between the two about three-fourths of an inch in the clear. Which space will hold nearly one pound of the wood, and the inner one about two ounces of coal; the residue of the coal is contained in a tin plate tube of the same size as the inner cylinder, and extended above it, with a register at the top, which is removed when the coal is put in. A tube leads the vapor up by the side of this to the top, where it is let out to burn in the manner gas would be, taking care to have a high temperature preserved the whole length. Into this lamp, the 22d inst. at a quarter past six o'clock, I put thirteen ounces of fat wood, and three ounces of charcoal, having previously dropped down three or four pieces of coal that were burning. It burned nearly regularly for three

* Than what? We presume than the liquor before mentioned as being distilled from wood.—*Edit.*

hours, when I retired, leaving it burning; but the coal was nearly consumed. The next day I added more coal, and kept it burning from three to four hours more. The wood had lost in the whole time only about six or seven ounces, and gave on an average, as appeared to me, about the light of two candles. It was lighted again the next night at seven: I had put in three ounces of coal, and seven of wood, filling it up with dry ashes. It burnt till nine o'clock, giving, I should think at least the light of six candles, but not without smoke: the wood lost five ounces. The next night at half past six it was lighted again, having eight ounces of wood and three of coal. It burnt with a most beautiful blue and white flame the first hour, inclining to a greater proportion of white towards the close. At the end of another half hour, it had become almost wholly white, and even intensely so, and so continued to half past eight, giving about the light of a candle: the coal had lost only one ounce, and the wood two. The next night, at half past six, I put in three ounces of coal: it burnt well, as the night before, two hours. The next morning I again filled it with coal, and it burnt with a small but intensely white flame about one hour and a half: the whole time without smoke. The wood had then lost three-fourths of its weight, or six ounces; and had burnt in the whole about six and a half hours.

It is said, that the water, if decomposed, can give out no more caloric than it receives. That is possibly correct, when applied solely to the combustibles, which decompose it. But the process here is very different, as I understand it. The water is decomposed by the combustible. If the oxygen were again to unite with the same hydrogen, there is perhaps nothing gained. If it unite to an equal quantity of hydrogen or carbon, disengaged from the combustible, still, so far there is perhaps neither gain nor loss. But if the hydrogen of the water find an abundant resupply of oxygen from the atmospheric air, with which it is so intimately mixed and blended, the heat evolved during the recomposition of the water, would be equal to the whole received during the decomposition: [plus what proceeds from the atmospherical oxigen employed to burn the hydrogen? *Ed.*] thereby doubling the quantity received from the combustible in its decomposition. This would certainly follow, (as it appears to me,) if the vapors of water and oil were to repel each other, so as to occupy twice or more the bulk of atmospheric air, than the vapour of the combustible would alone. Oil and water repel each other to a sensible distance, when in a cold liquid state. When at the high temperature of the vapour, being so very volatile, and divided into such very minute particles, they are evidently repelled so as to occupy a much larger volume, and to mix with a much greater quantity of atmospheric air. It needs no experiment to know, that charcoal barely ignited will decompose water. How much more rapid and violent must the process be here, where there is an abundance of atmospheric air on every side to assist and increase the combustion and decomposition, as well as for furnishing on the spot an abundant resupply of heat. What electricity has to do in combustion, it is not for me to say: but, that it assists in repelling the particles into a greater space, I trust there is no doubt: and from its general well known energy and activity, it evidently does not remain passive. If we apply the moist wick of a candle to the flame of another to light it, it is not possible for me to distinguish the sharp cracking reports from those of electricity.* In nature's greatest labratory, for the formation of carbonic acid gas, the process is carried on at a temperature not above blood heat: that is by something like a thousand millions of human beings, besides myriads of animals, incessantly breathing. I know not, that life is necessary, at this temperature for that purpose. But from what source the whole of the sensible heat, evolved by combustion, during the formation of the carbonic acid gas, or that evolved during the formation of water by the combustion of its component parts, as well as from many other processes, proceeds, I trust is as yet not fully known. It may therefore, for aught I know, be a fact, that much sensible heat, may be obtained by the decomposition and recomposition of water, if confined wholly to the combustible; but when an equal quantity of water is again recomposed from the atmospheric air and hydrogen of the decomposed water, solely, the oxygen, I should think, could not be lost, surrounded as it is, on all sides, by a highly inflammable vapor.

* May not this proceed from the decomposition of the water and the sudden conversion of some of it into steam as when drops of water fall into a kettle of boiling oil?—*Ed*

I add some of the advantages, (as they appear to me) which will and do result from obtaining light and heat by the decomposition of water, instead of forming permanent gas.

1. We are not troubled with that disagreeable smell, which accompanies carburetted hydrogen gas, unless carefully purified.

2. We obtain all the light, necessary for ordinary purposes, from the same combustibles, which are used for warming the apartment.

3. A stove supplied in this way requires less fuel for warming an apartment, than is demanded in any other mode with which I am acquainted, and less to warm and light the room at the same time, than to warm it only.

4. The apparatus for furnishing this light is very cheap: so simple that any person can manage it: so light and portable, that it may be placed on a table or on the mantlepiece, or carried about the house nearly as conveniently as a lamp and as the temperature need not be so high as a red heat, thin sheet iron must last a good while.

5. The whole heat, evolved during the combustion, is retained in the room, without rendering the air unpleasant or unhealthy. Better judges, however, will decide as to the latter.

6. The heat on ever so large a scale, will be nearly perfectly uniform. Stoves in my house, made of brick on this principle, (the wood however is put in at the side) burn from nine o'clock at night until nine, ten, and eleven the next day: keeping the room entirely warm, during the coldest nights of the winter past.*

Much however is yet to be learned in the small way. Different kinds of the fat wood, containing more or less water, require different degrees of heat to evaporate them so as to burn without smoke; so also with common tar, containing more or less water. The vapour, at first, always commences burning with a beautiful blue flame, or nearly blue, trimmed with a bright white. So it is with rosin, mineral coal, birch-bark, and pumpkin seeds. It becomes difficult in some measure, after about two thirds of the volatile

* The climate of Orford is severe—thermometer in the winter occasionally from 2[illegible]° to 30° of Fah. below 0. Mr. Morey does not state how it has been there during the late cold winter.—*Ed.*

parts of the substances are evaporated, to make them burn without smoke. It is however done by lessening the evaporation. It would undoubtedly be better economy, in the large way at least, to attach a small boiler for furnishing a supply of steam.

For manufactories or light houses, I see not a necessity of further experiments; especially if the wood of the pitch pine be used; which will be much the cheapest substance. The wood is evidently of more value, pound for pound, than the tar made from it.

I am respectfully, yours,

SAMUEL MOREY.

Orford, March 28th, 1820.

Remarks.—Mr. Gay Lussac, of Paris, in the Annales de Chimie, &c. for June 1819, has commented on Mr. Morey's method of producing light and heat, and stated some objections. It was my intention to translate this piece, and give it to the American public, along with Mr. Morey's communications, but the accidental loss of the No. of the Annales de Chimie in question, puts this, for the present, out of my power.—*Ed.*

Art. XIV. *On some curious and singular appearances of snow and hail, by the* Rev. Daniel A. Clark.

TO PROFESSOR SILLIMAN.

Dear Sir,

I SPENT the winter of 1808 and 9 in the county of Morris, in New-Jersey, when and where I witnessed a phenomenon which perhaps may never have been observed at any other place or time since the creation of the world, and yet I am not able to say but the appearance in some parts of the world may be common. If you think it an uncommon event, and should judge it worthy of notice in your Journal, the following statement is at your service.

There fell a deep snow I think about the middle of January. When it had lain upon the earth several days, the weather being very cold, there passed over us one evening, a cloud, from which there fell a small shower of rain. The cloud was suddenly carried off by a northern blast, which congealed the water in the very surface of the snow, and covered the face of the earth with ice. The moon was full and the evening very fine. When a sufficient time had elapsed to permit the ice to form, another cloud appeared, from which there fell a shower of snow to the depth, I should judge of three fourths of an inch. Then the sky suddenly cleared, the cold became very intense and the wind blew a gale. Nature now began her sport. Particles of the snow would move on the icy crust from twelve to twenty inches, and would then begin to roll making a track upon the ice shaped like an isosceles triangle. The balls enlarged according to circumstances. I passed in the morning under the south side of a long inclined plain, free from almost every kind of obstruction. In many instances the rolls had apparently descended the hill by their own gravity, aided by the wind which commenced the sport, until they reached the bottom, or lodged in the path, and were of the size of a barrel and some even larger. Thus the whole creation as far as the eye could see, was covered with snow balls differing in size, from that of a lady's muff, to the diameter of two and a half or three feet, hollow at each end to almost the very centre, and all as true as so many logs of wood shaped in a lathe.

I do not know the extent to which this Lusus naturæ was observed, but I believe to no very great extent. The oldest men in the neighbourhood had never witnessed the like phenomenon, and all were filled with amazement at the spectacle which the fields exhibited in the morning.

The exhibition depends on so many concurring circumstances, that I suppose it may never have happened in any other case. The rain must fall suddenly and freeze suddenly, in order to prepare a smooth unbroken surface. The snow must fall to a given depth, in order to be shoved before the wind, and must possess a certain degree of dampness in order to make it cohere as it moves. The wind must rise before the snow becomes fastened to the crust, and must blow very hard in order to commence and finish the curious process. And even then the balls had been small had not the declivity of a hill promoted the operation.

There was also, two years before, a fall of hail in the same county, which was to me in some respects new.—The hail stones were generally about one fourth or three eighths of an inch thick and of sufficient dimension in length and breadth to hide a shilling, and in many cases a cent, and almost every one *perforated* in the middle as if they had been held between the fingers, till the fingers by their warmth had melted away the middle and had met. When the perforation was not complete, there was in every case an inclination to perforation. The storm was tremendous, but of short duration and took place in the heat of summer.

I observed then and have many times observed since, that hail is usually accompanied by contrary winds which seem striving over our heads for the mastery. I wish sir, to ask you, is not the hail always produced by conflicting winds, which, in the place where they meet, force the atmosphere above the freezing point, and cause the vapour to congeal? And if this be the fact will not the hail be larger or smaller as in proportion to the strength of the contending tempests? When the winds are strong will not the hail rise during the first periods of its formation, and continue to rise while the stream of atmosphere which is setting upward can support its weight, and thus be kept the longer time above the freezing point and become so much the larger. The perforation in the case above mentioned was, I suppose, effected while falling, but by what means I know not. The hail might have been strung like so many beads.

Art. XV. *Remarks on Atmospheric Dust, in reply to* Mr. Rafinesque.

TO PROFESSOR SILLIMAN.

Sir,

BEING a subscriber to your Journal, I observe, (Vol. I. No. IV. p. 397,) an article from the ingenious and learned Mr. *Rafinesque, on Atmospheric Dust.* I confess I can hardly agree with that gentleman in several opinions which he there suggests, and if I am wrong in dissenting from him, science can never suffer from a free and liberal investigation into its principles. Many of the facts stated in the article referred to, are doubtless true, but, as I apprehend, attributed to wrong causes. I am not disposed to question that dusty molecules are visible on the highest mountains, and on the ocean, but I think all the phenomena may be accounted for by supposing that they arise from the roads, fields, woods, and other matter on the surface of the earth, disengaged by various causes. A brisk wind will raise it directly from the earth, and waft it to a great distance, it being so exceedingly subtle and tenurious as that the atmosphere will support it even in a perfect calm. Perhaps in our climate there is not a day in the course of fifty years in which there is not a sufficient breeze sometime in the course of the twenty-four hours, to set in motion what we call atmospheric dust. And occasionally immense quantities are raised. In the stillest times, vegetables and trees are constantly depositing decayed matter, and some part of this, before it reaches the earth, doubtless floats away on the air. But this, says Mr. R. "is only a consequence of the *first*," meaning that dust which it is the property of the air to deposit. Yet surely the clouds of dust, which are every where visible in a windy day, and that which is seen in a room when any extraordinary motion is produced, do not proceed from the atmosphere primarily. The only fact which he mentions, as tending in the least to invalidate the commonly received opinion on this subject, is, that dust is seen at sea. Now, whatever is supposed to be the origin of these molecules, certain it is that they are capable of floating a great while in the air, and of being carried to an immense distance. Is it absurd to suppose that the specific air which we once breathed sitting in our libraries, may now be floating 1500 miles off over the Atlantic? If not, the dust with which it was charged *here*, may still accompany it *there*. Besides, the dust which is visible at sea, is visible only when the ship is nearly or quite becalmed; and may it not then arise in a great measure from the deck of the ship?

Mr. R. "calculates that on an average, from six to twelve inches are accumulated over the ground in one hundred years." Taking his lowest estimate, six inches for one hundred years, the medium thickness of the deposit on the surface of the earth in 1800 years, will not be less than nine feet. But Mr. R. goes farther, and supposes that in former times the deposit must have been much more abundant than at present. So that I apprehend we should do his theory ample justice, by saying that the diameter of the earth is now, from this single cause, twenty-seven feet greater than it was at the birth of our Saviour. But if we examine the surface of the earth, we shall find there has been no such change. How happens it that rocks and stones are every where to be met with? Are they made by a fortuitous concurrence of atoms from aerial deposit? Do the minerals, so various in their primitive substances, in their kinds and composition, which are spread all over the surface of the earth, and which are collected and form the cabinets of the curious, do they owe their origin to atmospheric dust? Has the atmosphere the property of depositing one substance here, and another there, so as to make one tract of country clay, another gravel, and another rocks, and all lying in the same vicinity? But without pursuing the subject farther, I think the ideas already suggested are sufficient to show that Mr. R.'s theory, instead of accounting for any facts, is wholly irreconcileable with what we every where observe with respect to the operations of nature.

I am respectfully, your obedient servant.

X. Y. Z.

P. S.—*Sir*—If you think the foregoing remarks may deserve a place in your instructive Journal, please insert them.

Boston, Oct. 1, 1819.

Observation.—I have not the account at hand, and only advert from memory to the astonishing quantity of extremely fine, indeed *impalpable* dust, found not long since in the castle of Edinburgh, in Scotland, on opening an apartment, and a chest containing the Regalia of the ci-devant kingdom. My impression is, that they had been closed ever since the union, viz. two centuries, and that the dust, in a form light as down, was several inches thick. Whatever theory of atmospheric dust be adopted, this fact is very curious, and well worthy of being more accurately stated and preserved.—*Editor.*

FOR THE AMERICAN JOURNAL OF SCIENCE.

Art. XVI. *On the existence of Cantharidin in the Lytta Vittata or Potatoe Fly; by* J. Freeman Dana, M. D. *Lecturer on Chemistry &c.*

TO PROFESSOR SILLIMAN.

Dear Sir,

It appears from the experiments of Robiquet, mentioned by Dr. Thomson in the last edition of his System of Chemistry, that a peculiar substance exists in the Melöe Vesicatorius. To this substance Dr. Thomson has given the name *Cantharidin*, and it is supposed to be the peculiar matter which produces vesication.

It is well known that some other insects, beside the M. Vesicatorius, possess the power of blistering, and that this property belongs, in a remarkable degree, to the Lytta Vittata or Potatoe Fly, so common in this country. This insect, from the experiments of Dr. Gorham of Boston,* and of others, appears to possess vesicating powers in a higher degree even than the Spanish Fly, and it became an enquiry of some interest to know whether it contained a substance analogous to Cantharidin.

I digested a small quantity, 110 grains of the Potatoe Fly in warm distilled water for several days, and the fluid of a dark brown colour was then decanted; more water was then added, and the operation repeated until no farther action was exerted, and the last portion of water was poured off nearly colourless. The watery infusion had a pungent and rather a nauseous taste, and was evaporated by a very gentle heat until a dry extract was obtained; this was of a dark brown colour, tough, and difficult to cut like urea, and was pungent to the taste, leaving an impression on the tongue which remained some time. The dry extract being digested in highly rectified alcohol was divided into two portions, one of which was dissolved by the spirit, the other

* See the Medical papers of the Massachusetts Medical Society, No. II. Part II. p. 55; (and Dr. Nathaniel Dwight's Memoir.—Trans. of Conn. Acad. v. I. part I. p. 99.—*Ed.*)

remaining at the bottom of the vessel in flocculi; the clear alcoholic solution of an amber colour was poured into a retort, and the spirit drawn off by distillation; a reddish brown substance remained which possessed some peculiar properties. It was very pungent to the taste; when dry and warm it was brittle like rosin, and presented a rosinous fracture; after remaining some minutes exposed to the air it became soft like wax, or more like sulphur when prepared for making sulphur casts, and gradually deliquesced nearly to the consistence of tar or treacle at 60° or 70° Faht. It was readily soluble in water, as might be inferred from its deliquescence.

This substance was put into a portion of pure sulphuric ether; at first no change appeared, but after a few hours the substance softened, and by agitation the ether acquired a yellow colour; the ether was poured off and other portions added until they ceased to acquire colour. The substance did not appear to be much changed in its properties by the action of the ether, but when dried and exposed to the air, it again softened and deliquesced. The etherial solution was concentrated to nearly one third its bulk, and was then suffered to evaporate spontaneously in the open air. The substance remaining after the dissipation of the ether was glutinous and of a light yellow colour; very highly rectified alcohol was poured over it, and instantly assumed a yellow colour, while numerous minute crystalline plates appeared diffused through the liquid, and soon subsided; the small crystals were washed in alcohol and dried; they were in very minute quantity, white and pearly; the quantity was so small, that their properties could not be ascertained; they were placed on the tender skin between the fingers and soon excited itching and redness; probably full vesication would have been produced if a larger quantity had been used.

It was proposed to repeat these experiments on a larger and more extended scale, that the properties of the curious substances above mentioned might be more fully ascertained; but it was impossible to procure a sufficient quantity of the Fly in which numerous larvæ were not busily employed, and which probably caused the first infusions in water rapidly to putrify and exhale a most offensive odour.

I am disposed at present to believe, that the small crystalline plates above obtained, consist of Cantharidin; and that the above experiments are a strong confirmation of the idea that the vesicating property of insects depends on the presence of a peculiar substance which may possibly be proved to be a peculiar animal alkali.

With real esteem,
Your humble obedt. servt.
J. FREEMAN DANA.

Cambridge, June 10, 1819.

INTELLIGENCE AND MISCELLANIES.

1. *American Geological Society.*

AT the conclusion of our last number, we announced the formation of an American Geological Society and the passage of an act of Incorporation by the Legislature of Connecticut, conferring the necessary powers.

Agreeably to that act a number of gentlemen from different States, held a meeting on the morning of Sept. 6th, in the Philosophical Room of Yale College for the purpose of organizing the society.

Col. George Gibbs was called to the chair, and the plan of a constitution was laid before the meeting by a committee.

On the evening of the 7th, it was adopted, after undergoing various amendments.

A copy is subjoined with a list of the officers elected for the ensuing year.

Constitution of the American Geological Society.

Art. I.—There shall be a President, eight Vice-Presidents, one Recording Secretary, three Corresponding Secretaries, a Curator and Treasurer, a Committee of Nomination, and a Committee of publication; all of whom shall be annually elected.

Art. II.—The Society shall consist of not more than one hundred members :—and of not more than twenty-five honorary, and forty corresponding members.

Art. III.—Candidates for admission into the Society, must be proposed by the Committee of Nomination, and be chosen by three-fourths of the members present.

Art. IV.—The annual meeting of the Society, for the election of Officers, shall he held on the Tuesday preceding the second Wednesday of September, at such hour and place as shall be agreed upon from time to time.

Art. V.—The other stated meetings shall be on the first Mondays in December, March and June : and all the meetings may be adjourned by the Chairman, for not more than seven days from the dates above mentioned.

Art. VI.—Special meetings may be convened by resolution of the Society, or by public notice from the President; or, in case of his absence, from the acting Vice-President, which meetings shall be restricted to the special objects of the Society, without power to enact regulations, or admit members.

Art. VII.—Five members, including the President, or one of the Vice-Presidents, shall form a quorum.

Art. VIII.—Every member shall pay to the Treasurer an initiation fee of five dollars, and shall be subject to an annual payment of one dollar.

Art. IX.—The Treasurer shall pay no money from the Treasury of the Society without a vote for this purpose and an order signed by the presiding officer.

Art. X.—The Society shall be located, provisionally, at New-Haven.

Art. XI.—No alteration shall be made in the Constitution, unless it be proposed in writing, at one of the stated meetings, previous to the annual meeting in September, and shall be decided by a majority of two thirds of the members present, at the said annual meeting.

Art. XII.—In such points of order as are not noticed in this Constitution, the Society will conform to the established customs of other similar institutions.

Officers.

William Maclure, President.

George Gibbs,
Benjamin Silliman,
Parker Cleaveland,
Stephen Elliott,
Robert Gilmor, Jr.
Samuel Brown,
Robert Hare,
[Vacant.]
} Vice-Presidents.

T. Dwight, Porter, Rec. Sec.

J. W. Webster,
F. C. Schaeffer,
E. Hitchcock,
} Corresponding Secretaries.

T. D. Porter, Curator.

A. M. Fisher, Treasurer.

B. Silliman,
G. Gibbs,
P. Cleaveland,
R. Hare,
} Committee of Nomination.

George Gibbs,
J. W. Webster,
James Pierce,
} Committee of Publication.

The stated meeting for December having been postponed, a special meeting was held on the 26th of January, 1820, in the new Cabinet of Yale College.

Col. Gibbs, as first Vice President, took the chair.

Professor Silliman presented a memoir of considerable extent on parts of the counties of New-Haven and Litchfield, in Connecticut. He gave a connected view of the strata and formations from the old red sand stone, the green stone trap, and alluvial of New-Haven, through the succeeding clay slate, chlorite slate, and micaceous slate, to the Gneiss and Granite of the Alpine region of Litchfield county.

The extensive beds of white granular marble which alternate many times with the mica slate and gneiss of Litchfield county, and afford inexhaustible materials for architecture and the arts, were particularly noticed, as were the fine iron ore beds of Salisbury and Kent, and the spathic iron of Roxbury all of which are also situated in the gneiss and mica slate. Tremolite, garnet, staurotide, sappar, plumose mica stalactitical brown iron and graphic granite, occurred in fine specimens, in the tract described, and specimens of most of these were presented for the cabinet of the Society.

The same gentleman presented specimens of massive fluor spar, recently discovered in the parish of New-Stratford, town of Huntington, Connecticut, by Mr. Ephraim Lane, four miles south of his mine which affords bismuth, tungsten,* &c. According to Mr. Lane, this vein is two feet in width ; and its immediate walls are white granular limestone which forms an extensive bed in gneiss. This fluor spar appears at two places, distant a fourth of a mile, and, when the snow is gone, will probably be found to form a gigantic vein. It has been observed only since the snows fell, and was first noticed in some fragments of lime stone, which had been quarried for burning.

The vein is much penetrated by quartz, mica, feldspar, and talc, but, it has been hitherto examined only on the surface. It is principally massive and its structure foliated or coarsely granular, but it presents well defined cubical crystals. Its colours vary from white to deep violet and purple, and are, principally various shades of the two latter. But the most interesting circumstance relating to it is its splendid phosphorescence. The light emitted when, it is thrown, in a dark place, upon a hot shovel, *is the purest emerald green ;* pieces of an inch in diameter become in a few seconds, fully illuminated, and the light is so strong and enduring, that when carried into a room lighted by candles, or, by the diffuse (not direct) light of the sun they still continue distinctly luminous and the light dies away very gradually as the mineral cools. This interesting property was exhibited to the members of the society. Is not this variety of fluor spar *then the true chlorophane of Siberia ?*

Prof. S. presented to the Society specimens of the green serpentine marble found near New-Haven, and which, according to the opinion of Mr. Brongniart of Paris, is the verd antique marble.

Col. Gibbs presented Smith's Geological Map of England, and various geological specimens ; among which were varieties of the granite rocks of Haddam, Connecticut. These rocks contain tourmaline, garnets, sometimes of very great size—beryls and crysoberyl, both massive and crystalized. This being the only locality known in which the crysoberyl occurs in place, the specimens are therefore very interesting.

* See Vol. I, page 316 of this Journal.

Mr. T. D. Porter presented some of the finest crystals of red oxid of titanium that have been any where found; the following memorandum accompanied them.

This titanium which I discovered in 1818, exists very well crystalized, and in comparative abundance, in masses of quartz which are scattered over the surface throughout the counties of Amherst, Campbell and Bedford, about twenty miles above Richmond in Virginia. Probably also it may be found in other counties contiguous to these, as the same rocks occur very extensively in all that quarter of the state; but I never had an opportunity to make any examination except in those I have mentioned.

Many of the specimens which I procured are superior both in size and in beauty, to any of the same species in the Cabinets which I have seen. A fragment of one crystal which I obtained, measures $1\frac{1}{10}$ in chesin diameter, and others are nearly as large. I have one specimen $3\frac{9}{10}$ inches in length, and another more than $3\frac{1}{4}$: both these are mutilated—the latter is broken off at each end, and was probably much larger; it is of the size of one's finger. The larger specimens are very liable to be thus injured, being exceedingly brittle. Their fracture is *commonly* foliated longitudinally and vitreous in the other direction. Frequently they are completely penetrated by quartz in the same manner as the green tourmaline of Massachusetts is by the Rubellite.

Like the different varieties of schorl, the greater part of the crystals were so compressed and striated, that their figure was very variable, oftener nearly cylindrical than of any regular prismatic form. I met with two or three specimens which were four sided prisms, truncated on each of the angles, having their terminations broken off and with a single crystal of four sides, which like those of the specimens just mentioned, seemed to meet at *right* angles and terminated very handsomely by a pyramid, whose sides corresponded with those of the prism. Many examples of crystalline termination were observed, but generally they were exceedingly irregular; sometimes one of the terminal planes was so large as almost entirely to obliterate the remainder. I believe I saw but two crystals with both ends perfect, among more than a hundred specimens which I collected.

A large proportion of the titanium found here, exhibited that peculiarity of configuration which is so characteristic of this mineral termed *geniculation.* In some cases a crystal was bent at but one angle ; in others at many—and in others still, while the specimen was perfectly straight and smooth on one side, the opposite was marked by many flexures, a part only of the molecules, having apparently been subject to the law that determined to this angular form. Two specimens fell in my way which had all the angles rounded, appearing as if they had suffered partial fusion. Instances of the reticulated variety were rare.

The colour of the oxid, when taken from the interior of the masses in which it was imbedded, was a beautiful red, often accompanied by translucency ; but that more exposed to the weather was commonly opake and almost black.

P. S. The Virginia titanium, although infusible by the common blow pipe, melts under the flame of the compound blow pipe of Prof. Hare, but is not reduced to the metallic state.

The Society directed Cases to be procured to receive specimens which may be presented.

In accordance with the above direction, provision is now made to preserve and display a collection as fast as it shall be formed. By permission it will be located for the present in the new apartment devoted to the cabinet of Col. Gibbs, and of Yale College.

It is understood to be the wish of the Society, that its members and others would forward specimens illustrative of American Geology and Mineralogy. The names of the donors will be duly recorded, and their donations will be properly acknowledged.

2. *Curious Geological Facts.*

In the Quarterly Review for Dec. 1819, No. 43, p. 52, the following very interesting fact is mentioned. It is introduced in giving an account of the quarries of marble from which the blocks are taken for the construction of the celebrated Break-water at Plymouth, in England : " The quarries are situated at Oreston, on the eastern shore of Catwater; they lie under a surface of about twenty-five acres, and were purchased from the Duke of Bedford for

£10,000. They consist of one vast mass of compact close-grained marble, many specimens of which are beautifully variegated; seams of clay however are interposed through the rock, in which there are also large cavities, some empty, and others partially filled with clay. In one of these caverns in the solid rock, fifteen feet wide, forty-five feet long, and twelve feet deep, filled nearly with compact clay, were found imbedded fossil bones belonging to the rhinoceros, being portions of the skeletons of three different animals, all of them in the most perfect state of preservation, every part of their surface entire to a degree which Sir Everard Home says he had never observed in specimens of this kind before. The part of the cavity in which these bones were found was seventy feet below the surface of the solid rock, sixty feet horizontally from the edge of the cliff where Mr. Whitby began to work the quarry, and one hundred and sixty feet from the original edge by the side of the Catwater. Every side of the cave was solid rock: the inside had no incrustation of stalactite, nor was there any external communication through the rock in which it was imbedded, nor any appearance of an opening from above being enclosed by infiltration. When, therefore, and in what manner these bones came into that situation, is among the secret and wonderful operations of nature which will probably never be revealed to mankind."

The perusal of the above brought to my recollection a fact if possible still more astonishing: it is mentioned by Count Bournon in his Mineralogy, and as that work has (I believe) never been translated, I will here give the passage entire.

" During the years 1786, 7, and 8, they were occupied near Aix in Provence, in France, in quarrying stone for the rebuilding, upon a vast scale, of the Palace of Justice. The stone was a limestone of a deep grey, and of that kind which are tender when they come out of the quarry, but harden by exposure to the air. The strata were separated from one another by a bed of sand mixed with clay, more or less calcareous. The first which were wrought presented no appearance of any foreign bodies, but, after the workmen had removed the ten first beds, they were astonished, when taking away the eleventh, to find its inferior surface, at the depth of forty or fifty feet, covered with shells. The stone of this bed having been removed, as they were taking away a stratum of argillaceous sand, which separated the eleventh bed from the twelfth, they found stumps of columns and fragments of stones half wrought, and the stone was exactly similar to that of the quarry : they found moreover coins, handles of hammers, and other tools or fragments of tools in wood. But that which principally commanded their attention, was a board about one inch thick and seven or eight feet long ; it was broken into many pieces, of which none were missing, and it was possible to join them again one to another, and to restore to the board or plate its original form, which was that of the boards of the same kind used by the masons and quarry men : it was worn in the same manner, rounded and waving upon the edges.

" The stones which were completely or partly wrought, had not at all changed in their nature, but the fragments of the board, and the instruments, and pieces of instruments of wood, had been changed into agate, which was very fine and agreeably coloured. Here then, (observes Count Bournon,) we have the traces of a work executed by the hand of man, placed at the depth of fifty feet, and covered with eleven beds of compact limestone : every thing tended to prove that this work had been executed upon the spot where the traces existed. The presence of man had then preceded the formation of this stone, and that very considerably since he was already arrived at such a degree of civilization that the arts were known to him, and that he wrought the stone and formed columns out of it."

3. *Fossil Bones found in red sand stone, communicated by* Professor NATHAN SMITH.

Mr. Solomon Ellsworth, Jun. of East-Windsor, (Conn.) has politely favoured me with some specimens of fossil bones, included in red sand stone. Mr. Ellsworth informs me that they were discovered by blasting in a rock for a well ; they were 23 feet below the surface of the earth, and 18 feet below the top of the rock. Unfortunately, before Mr. Ellsworth came to the knowledge of what was going on, the skeleton had been blown to pieces, with the rock which contained it, and several pieces of bones had been picked up, and then lost. The specimens which I have seen are still inclosed in the rock, but from their appearance, it is possible that they are human bones. Mr. Ellsworth states that the bones were found in a horizontal position across the bottom of the well, as he thinks nearly to the extent of six feet. It is to be hoped that the pieces of bones, when they are cleared of the rock which incloses them, will enable us to ascertain the fact whether they are human bones, or the bones of brute animals. Possibly by examining more of the fragments of the rock which have been thrown out by blasting, we shall find some bone that will be decisive of the genus of the animal to which they belong. Whether they are human or brute animal bones, it is an important fact as it relates to Geology.

Note by the Editor.—The rock in which these bones were found, was the old red sand stone of Werner, which, with superincumbent ridges of green stone trap, forms an extensive region from the sea shore at New-Haven to the state of Vermont, and intersects the states of Connecticut and Massachusetts. This sand stone region, which is more than one hundred and ten miles long, and varies in breadth from three miles to twenty-five, touches the primitive on both sides, and at the northern end, the boundary rocks being, generally, mica slate and clay slate. The discovery of bones, in such a formation, so nearly allied to the primitive, (and in fact the sand stone rock is very firm, and made up of large portions of quartz, feldspar and mica—the *palpable ruins of granite*, with no cement, but finer portions of the same blended with oxid of iron,) cannot but be considered as very interesting. The bones were evidently those of a perfect and considerably large animal—some of the ribs were preserved; there was a long cylindrical cavity, which appeared to have been occupied by an os humerus remaining in the rock, with one of its condyles, and a portion of the sternum—of that part which is terminated by the ensiform cartilage. Other bones were so completely encased in the rock, that it could not be seen what they were. Professors Smith, Ives, and Knight, of the Medical Institution of Yale College, all admitted *the possibility* that they might be human bones, but did not consider the specimens as sufficiently distinct to form the basis of a certain conclusion. This is understood also to be the opinion of Professor Mitchell, of New-York.

4. *Documents and Remarks respecting the Sea Serpent; communicated by* Professor Jacob Bigelow, *of Boston.*

Mr. Silliman,

In the year 1817, an unusual marine phenomenon excited notice in the harbour of Gloucester, Mass. being one with which the mariners and fishermen of that place were unacquainted. Its character and appearance have since been well known to the public under the name of the *Sea Serpent.*

The accounts of this phenomenon given under oath by various witnesses, also some accounts of previous appearances of the same kind, were collected and published by the Linnæan Society of New-England, that the public might possess a fair and correct statement of what had been observed in regard to so interesting a subject. In the following year Capt. Rich of Boston, went on an expedition fitted out for the purpose of taking the Sea Serpent, and after a fruitless cruise of some weeks, brought into port a fish of the species commonly known to mariners and fishermen by the name of Thunny, Albicore or Horse Mackerel, the *Scomber thynnus* of Linnæus, and which fish he asserted to be the same as that denominated Sea Serpent. This disappointment of public curiosity was attended at the time by a disbelief on the part of many, of the existence of a distinct marine annimal of the serpent kind, or of the dimensions and shape represented by the witnesses at Gloucester and elsewhere. In some of the scientific journals remarks have been published, in which the testimony of these witnesses is announced to be an " absurd story," attributable to a " defective observation connected with an extravagant degree of fear."*

As the friends of science can have no object in view more important than the attainment of truth, it is proper to submit to the public consideration some additional evidence in regard to the size and shape of this marine annimal which has come to light since the publication of Capt. Rich's letter on the subject. This evidence is partly the result of observations made during the present year, and partly the contents of a communication made to the American Academy of Arts and Sciences fifteen years ago, but which, having been mislaid, has not before been published. The reader will judge whether it is a " defective observation" which has produced a remarkable coincidence between witnesses in different periods and places, unknown to each other; or whether it was an " extravagant degree of fear" which induced the commander of an American frigate to man his

* See Thomson's annals for Jan. 1819, a letter from Mr. Say of Philadelphia. In the American Journal of Science vol. I. p. 260, is a note from the same author, on the identity of *Scoliophis* with *Coluber constrictor*. As this gentleman probably received his knowledge on the snbject from page 40th of the Linnæan Society's report, it might have been decorous in him to have noticed the source from which he got his information.

boats and go with his marines in pursuit of this unknown animal. It may be proper to add that the original letters constituting the communication last alluded to, are in the hands of the corresponding Secretary of the Academy, where they may be seen. It is hoped that the unsuccessful termination of Capt. Rich's cruise will not deter others from improving any future opportunities which may occur for solving what may now perhaps be considered the most interesting problem in the science of Natural history.

(Copy.) WISCASSET, *May* 22, 1804.

To the Honorable JOHN Q. ADAMS, *corresponding Secretary of the American Academy of Arts and Sciences.*

SIR,

As one object of the Academy is to notice and preserve discoveries in *Natural History*, I am induced to communicate to the Society the following account of a *Sea Serpent*, which I have lately collected.

It will probably be within the recollection of some persons conversant with Navigation, that in the course of a few years past, there have been vague reports of an animal of this description having been seen in or near Penobscot Bay. But little credit however, was attached to the story, and no particular authentic account has yet been given to the public on the subject.

A few months ago I happened to hear related the story of one, which was seen in the Bay of Penobscot in 1802. And for my own satisfaction, I have been inquisitive relative to the truth of the account, and to the general evidence of the existence of such an animal. The first correct information I received was from the perusal of a letter to Rev. Alexander McLean, from Rev. Mr. Cummings of Sullivan; which is enclosed, and marked A. and some remarks were added by Mr. McLean at my request. The account was liable to some objections, and not so particular as might be wished. I therefore wrote Mr. Cummings, and in reply, received a statement more in detail, which accompanies this, and is marked B.

I was afterwards informed, that George Little Esq. late commander of the Boston frigate, saw a sea monster similar to the one described by Mr. *Cummings*, in the time of the revolutionary war with Great Britian ; and as I was anxious for all the information that was to be had, I wrote him on the subject, and he forwarded the enclosed (marked C.) in answer to my letter. I have also the testimony of a Capt. *Crabtree* of Portland, an intelligent man, which is direct and positive. This is also enclosed and marked D. It was written in his presence and received his signature, as a correct statement.

All this evidence, I think cannot fail to establish the fact, *that a large Sea Serpent has been seen in and near the Bay of Penobscot.* The existence of such a *Monster* can no longer be reasonably disputed. But whether he constantly resides in that vicinity, or whether he coasts further south or north, during a part of the year, more particular information is necessary to ascertain. Nor is it known on what species of fish he subsists. By this communication I have it in view only to furnish evidence of the actual existence of the animal. It will probably operate in favour of further information, and lead to a particular history of this hitherto undescribed Serpent.

I am, with great esteem,
Your humble servant,
A. BRADFORD.

A. SULLIVAN, *Aug.* 17*th*, 1803.

My Dear Sir,

With peculiar pleasure I comply with your request, though the urgency of my affairs must excuse my brevity. It was sometime in July 1802 that we saw this extraordinary sea monster, on our passage to Belfast, between Cape Rosoi and Long Island. His first appearance was near Long Island. I then supposed it to be a large shoal of fish with a seal at one end of it, but wondered that the seal should rise out of water so much higher than usual ; but, as he drew nearer to our boat, we soon discovered that this whole appearance was but one animal in the form of a serpent. I immediately perceived that his mode of swimming was exactly such as had been described to me by some of the people on Fox Islands, who had seen an animal of this kind before, which must confirm the veracity of their report. For this creature had not the horizontal but an ascending and descending serpentine motion. This renders it highly probable that he never moves on land to any considerable distance and that the water is his proper element. His head was rather larger than that of a horse, but formed like that of a serpent. His body we judged was more than sixty feet in length. His head and as much of his body as we could discover was all of a blue colour except a black circle round his eye. His motion was at first but moderate, but when he left us and proceeded towards the ocean, he moved with the greatest rapidity. This monster is the sixth of the kind, if our information be correct, which has been seen in this bay, within the term of eighteen years. Mrs. Cummings, my daughter and Miss Martha Spring were with me in the boat at that time, and can attest to the above description.

I continue yours in christian affection,

ABRAHAM CUMMINGS.

Rev. Alexander McLean.

On my way to the Schooden not meeting with Mr. Cummings at home, I wrote him a few lines, requesting he would leave me an account of the sea monster, he saw last summer, if he should be from home on my return. The foregoing is his account which may be gratifying to you. Perhaps it may be of the same kind with the great Sea Snake, of which Pontoppidan, Bishop of Bergen, gives an account. One of the same kind was seen above thirty years ago, by the deceased Capt. Paul Reed, of Boothbay; another was seen in Muscongus Bay in time of the American war, two miles from the place where I lived then, and another soon afterwards off Meduncook. These were all I ever heard of, seen on this coast, but I never could have such a particular account of them as Mr. Cummings here gives. A. McLEAN.

B. Sullivan, *Jan.* 18*th*, 1804.

Rev. and Dear Sir,

I can recollect nothing material which would render my description of that animal more convincing. I am not sure that this motion was ascending and descending; all we can say is, *it appeared so to us*,* (for he was seen not only by me, but by three other persons.) Perhaps his nearest distance from us was ten rods. The sea was then very smooth, and very little wind, but still there was such a constant rippling of the water over his body, that I could not distinctly observe the magnitude or colour of any part but his head and neck. The degree of his rapidity I cannot explain. But certain I am that he had a serpent's head, of a colour as blue as possible, and a black ring round his eye. The head was three feet in circumference *at least*. Who ever saw fifty or sixty porpoises moving after each other in a right line, and in such a manner that those who formed the rear were no larger than haddock and mackerel, and none but the foremost shewed his head? Who ever saw a serpent's head upon a porpoise or whale? We saw him swim as far as from Long Island to the Cape before he disappeared. His head and neck all the time out of water. Now who ever saw a porpoise swim so great a distance without immerging at all? Two young men on Fox Island, intelligent and credible, saw an animal of this kind about five years since, as they then informed me. They told me, that the serpent which they saw was about sixty feet long, and appeared to have an ascending and descending motion. A few years before, perhaps ten years since, two of those large serpents were seen by two other persons on that Island, as their neighbours informed me. About twenty years since, two of those serpents, they say, were seen by one Mr. Crocket, who then lived upon Ash Point. This is the best information which you can obtain from

Your Friend and Servant,

ABRAHAM CUMMINGS.

Rev. Alden Bradford.

P. S. The head and neck of the animal were of the same colour.

C. Marshfield, 13*th March*, 1804.

Sir,

In answer to yours of the 30th of January last, I observe, that in May, 1780, I was lying in Round Pond, in Broad

* His real motion might be horizontal.

Bay, in a public armed ship. At sunrise, I discovered a large Serpent, or monster, coming down the bay, on the surface of the water. The Cutter was manned and armed. I went myself in the boat, and proceeded after the Serpent. When within a hundred feet, the marines were ordered to fire on him, but before they could make ready, the Serpent dove. He was not less than from 45 to 50 feet in length; the largest diameter of his body, I should judge, 15 inches; his head nearly of the size of that of a man, which he carried four or five feet above the water. He wore every appearance of a common black snake. When he dove he came up near Muscongus Island—we pursued him, but never came up within a quarter of a mile of him again.

A monster of the above description was seen in the same place, by Joseph Kent, of Marshfield, 1751. Kent said he was longer and larger than the main boom of his sloop, which was 85 tons. He had a fair opportunity of viewing him, as he was within ten or twelve yards of his sloop.

I have the honor to be, sir,

Your friend and humble servant,

GEO. LITTLE.

Alden Bradford, Esq.

D.

Capt. Crabtree, now of Portland, (late of Fox Islands, in the bay of Penobscot,) declares, that in the year 1777, or 1778, upon information of a neighbor, that a large Serpent was in the water, near the shore, just below his house, and having often been told by individuals that they had before seen a similar sea-monster in that quarter, and doubting of the correctness of their reports, was induced to go down to the water to satisfy his own mind—that he saw a large animal, in the form of a Snake, lying almost motionless in the sea, about thirty rods from the bank where he stood—that his head was about four feet above water—that, from the appearance of the animal, he was 100 feet in length—that he did not go off to the animal through fear of the consequences, and that he judged him to be about three feet diameter. He also says, that before that time, many people, living on those islands, on whose reports he could depend, had declared to him that they had seen such an animal—and that more than one had been seen by several persons together.

Signed, ELEAZER CRABTREE.

The following documents have been already published in the newspapers, but, from their importance and recent origin, are now re-printed, in connexion with the preceding :—

From the Boston Daily Advertiser.

THE SEA SERPENT.

The recent appearance of this animal at Nahant, in the view of several hundred persons, has furnished, perhaps, more conclusive proof of his existence, than any that has before been made public. For the satisfaction of our readers, we have procured a copy of the following letter, which gives a very clear and intelligible description of his appearance and movements. We have heard verbal statements from a great number of gentlemen, all of whom agree in substance with what is here related.

Copy of a letter from James Prince, *Marshal of the District, to the Hon. Judge* Davis, *dated*

Nahant, *Aug.* 16*th*, 1819.

Dear Sir,

I presume I may have seen what is generally thought to be the Sea Serpent—I have also seen my name inserted in the evening newspaper printed at Boston on Saturday, in a communication on this subject. For your gratification, and from a desire that my name may not sanction any thing beyond what was presented and passed in review before me, I will now state that which, in the presence of more than two hundred other witnesses, took place near the long beach of Nahant, on Saturday morning last.

Intending to pass two or three days at Nahant, with my family, we left Boston early on Saturday morning. On passing the half-way house, on the Salem turnpike, Mr.

Smith informed us the Sea Serpent had been seen the evening before at Nahant beach, and that a vast number of people from Lynn, had gone to the beach that morning, in hopes of being gratified with a sight of him: this was confirmed at the hotel. I was glad to find I had brought my famous mast-head spy-glass with me, as it would enable me, from its form and size, to view him to advantage, if I might be so fortunate as to see him. On our arrival on the beach, we associated with a considerable number of persons, on foot and in chaises—and very soon an animal of the fish kind made his appearance. His head appeared about three feet out of water; I counted thirteen bunches on his back: my family thought there were fifteen—he passed three times at a moderate rate across the bay, but so fleet as to occasion a foam in the water—and my family and myself, who were in a carriage, judged he was fifty feet in length, and, at the extent, not more than sixty; whether, however, the wake might not add to the appearance of his length; or whether the undulation of the water, or his peculiar manner of propelling himself, might not cause the appearance of protuberances, I leave for your better judgment. The first view of the animal occasioned some agitation, and the novelty perhaps prevented that precise discrimination which afterwards took place—as he swam up the bay, we and the other spectators moved on, and kept abreast of him; he occasionally withdrew himself under water, and the idea occurred to me that his occasionally raising his head above the level of the water, was to take breath, as the time he kept under was on an average about eight minutes; after being accustomed to view him, we became more composed; and his general appearance was as above delineated. Mrs. Prince and the coachman having better eyes than myself, were of great assistance to me in marking the progress of the animal; they would say he is now turning, and by the aid of my glass I saw him distinctly in this movement; he did not turn without occupying some space, and taking into view the time and space which he found necessary for his ease and accommodation, I adopted it as a criterion to form some judgment of his length—I had seven distinct views of him from the long beach so called, and at some of them the animal was not more than an hundred yards distance. After being on the long beach about an hour, the animal disappeared, and I proceeded on towards Nahant; but on passing the second beach, I met Mr. James Magee, of Boston, with several ladies in a carriage, prompted by curiosity to endeavor to see the animal, and we were again gratified beyond even what we saw in the other bay; which I concluded he had left in consequence of the number of boats in the offing in pursuit of him—the noise of whose oars must have disturbed him, as he appeared to us to be a harmless timid animal. We had more than a dozen different views of him, and each similar to the other; one however so near, that the coachman exclaimed, "Oh, see his glistening eye." Thinking I might form some calculation of his length by the time and distance of each turn; and taking an angle with my two hands of the length he exhibited, that is to say, from his head to his last protuberance, and applying the same angle to other objects, I feel satisfied of the correctness of my decision that he is sixty feet long, unless the ripple of his wake deceived me—nor my dear sir, do I undertake to say he was of the snake or eel kind, though this was the general impression of my family, the spectators, and myself. Certainly it is a very strange animal. I have been accustomed to see whales, sharks, grampuses, porpoises, and other large fishes, but he partook of the appearance of none of these. The whale and the grampus would have spouted —the shark never raises his head out of water, and the porpoise skips and plays; neither of these has such appearances on the back or such a head as this animal. The shark, it is true, has a fin on his back, and often the fluke of his tail is out of the water; but these appendages would not display the form, and certainly not the number of protuberances, which this animal exhibited; nor is it the habit of the shark to avoid a boat. The water was extremely smooth, and the weather clear: we had been so habituated to see him, that we were cool and composed—the time occupied was from a quarter past eight to half past eleven —a cloud of witnesses exceeding two hundred, brought together for a single purpose, were all alike satisfied and united as to appearances, and as to the length and size of the animal; but you must deduct the influence which his passage through the water and the manner he propelled himself might have as to the apparent protuberances on his back, and the ripple occasioned by his motion on his real length, of all which you can judge equally well as and better than myself. I must conclude there is a strange animal on our coast—and I have thought an unvarnished statement might be gratifying to a mind attached to the pursuit of natural science, and aid in the inquiries on a controverted question, which I knew to have interested you. I have ventured on the description, being also induced to hope, that if any thing of the marvellous is stated as coming from me, you will correct it.

Accept the respects and attention of,

Dear Sir, yours sincerely,

JAMES PRINCE.

Hon. Judge Davis, Nahant, Aug. 16th, 1819.

Extract of a letter from Mr. Cheever Felch, *Chaplain of the United States' Ship Independence of* 74 *guns, to the Editor of the Boston Centinel.*

Gloucester, *Aug.* 26, 1819.

" *Dear Sir,*

" Others having taken in hand to give some account of the Sea Serpent, I know not why I should not have the same liberty. Being on this station, in the United States schooner Science, for the purpose of surveying this harbor, we were proceeding this morning down the harbor, in the schooner's boat; when abreast of Dallivan's Neck, William. T. Malbone, Esq. commander of the schooner, seeing some appearance on the water, said—" *there is your Sea Serpent*," meaning it as a laugh on me, for believing in its existence; but it proved to be no joke. The animal was then between thirty and forty yards distance from us. Mr. Malbone, Midshipman Blake, myself, and our four boatmen, had a distinct view of him. He soon sunk; but not so deep but we could trace his course. He rose again within twenty yards distance of us, and lay some time on the water. He then turned, and steered for Ten Pound Island; we pulled after him; but finding that he was not pleased with the noise of our oars, they were laid in, and the boat skulled. We again approached very near him. He continued some length of time, plying between Ten Pound

Island and Stage Point. As he often came near the Point, we thought we could get a better view of him there, than from the boat, of which he seemed suspicious. Mr. Malbone and myself landed; and the boat was sent to order the schooner down, for the purpose of trying what effect a twelve pound carronade would have upon him. He did not remain long after we landed, so that I was unable to effect my intention, of ascertaining, accurately, his length, with my instruments. From my knowledge of aquatic animals, and habits of intimacy with marine appearances, I could not be deceived. We had a good view of him, except the very short period while he was under water, for half an hour.—His colour is a dark brown, with white under the throat. His size, we could not accurately ascertain, but his head is about three feet in circumference, flat and much smaller than his body. We did not see his tail; but from the end of the head to the fartherest protuberance, was not far from one hundred feet. I speak with a degree of certainty, from being much accustomed to measure and estimate distances and length. I counted fourteen bunches on his back, the first one, say ten or twelve feet from his head, and the others about seven feet apart. They decreased in size towards the tail. These bunches were sometimes counted with, and sometimes without a glass. Mr. Malbone counted thirteen, Mr. Blake thirteen and fourteen, and the boatmen about the same number. His motion was sometimes very rapid, and at other times he lay nearly still. He turned slowly, and took up considerable room in doing it. He sometimes darted under water, with the greatest velocity, as if seizing prey. The protuberances were not from his motion, as they were the same whether in slow or rapid movement. His motion was partly vertical and partly horizontal, like that of fresh water snakes. I have been much acquainted with the snakes in our interior waters. His motion was the same. I have given you in round numbers, one hundred feet, for his length; that is, what we saw; but I should say he must be one hundred and thirty feet in length, allowing for his tail. There were a considerable number of birds about the Sea Serpent, as I have seen them about a Snake on shore. That there is an aquatic animal in the form of a Snake, is not to be doubted. Mr. Malbone, till this day, was incredulous. No man would now convince him, there was not such a being. The sketch or picture of Marshal Prince, is perfectly correct. I could not, with my own pencil, give a more correct likeness.

With respect,

Your obedient servant,

CHEEVER FELCH.

Major B. Russell."

Brookline, *August* 19, 1819.

Dear Sir,

I very willingly comply with your request to state what I saw of the *Sea Serpent* at *Nahant*, on Saturday last, particularly as I happened to see it under favourable circumstances to form a judgment, and to considerable advantage in point of position and distance.

I got into my chaise about 7 o'clock in the morning, to come to Boston, and on reaching the long Beach observed a number of people collected there, and several boats pushing off and in the offing. I was speculating on what should have occasioned so great an assemblage there without any apparent object, and finally had concluded that they were some Lynn people who were embarking in those boats on a party of pleasure to Egg Rock, or some other point.

I had not heard of the *Sea Serpent* being in that neighborhood, and I had not lately paid much attention to the evidences which had been given of its existence ; the idea of this animal did not enter my mind at the moment.

As my curiosity was directed towards the boats to ascertain the course they were taking, my attention was suddenly arrested by an object emerging from the water at the distance of about one hundred or one hundred and fifty yards, which gave to my mind at the first glance the idea of a horse's head. As my eye ranged along I perceived at a short distance eight or ten regular bunches or protuberances, and at a short interval three or four more. I was now satified that the *Sea Serpent* was before me, and after the first moment of excitement produced by the unexpected sight of so strange a monster, taxed myself to investigate his appearance as accurately as I could

My first object was the Head, which I satisfied myself was serpent shaped, it was elevated about two feet from the water, and he depressed it gradually, to within six or eight inches as he moved along. I could always see under his chin, which appeared to hollow underneath, or to curve downward. His motion was at that time very slow along the Beach, inclining towards the shore; he at first moved his head from side to side as if to look about him. I did not see his eyes, though I have no doubt I could have seen them if I had thought to attend to this. His bunches appeared to me not altogether uniform in size, and as he moved along some appeared to be depressed, and others brought above the surface, though I could not perceive any motion in them. My next object was to ascertain his length. For this purpose I directed my eye to several whale boats at about the same distance, one of which was beyond him, and by comparing the relative length, I calculated that the distance from the animal's head to the last protuberance I had noticed, would be equal to about five of those boats. I felt persuaded by this examination that he could not be less than eighty feet long; as he approached the shore and came between me and a point of land which projects from the eastern end of the beach, I had another means of satisfying myself on this point.

After I had viewed him thus attentively for about four or five minutes, he sunk gradually into the water and disappeared; he afterwards again made his appearance for a moment at a short distance.

My first reflection after the animal was gone, was, that the idea I had received from the description you gave of the animal you saw at *Gloucester*, in 1817, was perfectly realized in this instance; and that I had discovered nothing which you had not before described. The most authentic testimony given of his first appearance there seemed to me remarkably correct; and I felt as if the appearance of this monster had been already familiar to me.

After remaining some two or three hours on the beach, without again seeing him, I returned towards Nahant; and in crossing the small beach had another good view of him, for a longer time, but at a greater distance. At this time he moved more rapidly, causing a white foam under the chin, and a long wake, and his protuberances had a more uniform appearance. At this time he must have been seen by two or three hundred persons on the beach and on the heights each side, some of whom were very favourably situated to observe him.

I am, very respectfully,
Your obedient servant,
SAMUEL CABOT.

Col. T. H. PERKINS.

It is almost superfluous to add, that Mr. Cabot and his friend Col. Perkins, are gentlemen of the first standing and consideration.—*Editor.*

I, Hawkins Wheeler, of Fairfield, in the county of Fairfield, and state of Connecticut, mariner, commander of the sloop Concord, of said Fairfield, in her late passage from New-York to Salem, in the county of Essex and Commonwealth of Massachusetts, on oath declare, that during the said passage from New-York to Salem, to wit, on Monday, the 6th day of June instant, at about 5 o'clock in the morning, the sloop being, as near as I could judge, 15 miles N. W. of Race Point, and within sight of Cape Ann, I was at the helm of the sloop, and saw, directly a-head, (the course of the vessel being N. W.) something that resembled a Snake, about 100 yards distant from the sloop, moving in a S. W. direction. The animal moved in that direction, till he had passed athwart the course of the sloop, and appeared directly over the weather bow, when he altered his course to S. E. At this time he had been visible about five minutes, when he sunk, and in about six or eight minutes after, appeared again directly over the weather quarter, about the same distance from the sloop—he continued in that course about five or six minutes, when he sunk again, and I saw him no more. His motion was at the rate of about four miles an hour, when he passed ahead; but after he appeared again on the quarter, his motion was less rapid. To the best of my judgment he was not more than 100 yards from the vessel—the weather was good and clear—it was almost calm, with a light air of wind from the S. the vessel was going about two knots—I had a fair and distinct view of the creature, and from his appearance am satisfied that it was of the serpent kind. The creature was entirely black; the head, which perfectly resembled a snake's, was elevated from four to seven feet above the surface of the water, and his back appeared to be composed of bunches or humps, apparently about as large as, or a little larger than a half barrel; I think I saw as many as ten or twelve, but did not count them; I considered them to be caused by the undulatory motion of the animal—the tail was not visible, but from the head to the last hump that could be seen, was, I should judge, 50 feet. The first view I had of him appeared like a string of empty barrels tied together, rising over what little swell of the sea there was. What motion I could discern in the body of the animal was undulatory, but he evidently moved his tail under water, and the ripples produced by it indicated a sweeping motion, making a wake as large as that made by the sloop.

HAWKINS WHEELER.

Essex, ss. June 9th, 1819.—Then Hawkins Wheeler personally appeared, and made oath that the foregoing affidavit by bim subscribed, contains the truth, the whole truth, and nothing but the truth. Before me,

THEODORE EAMES, *Justice of the Peace.*

I, Gersham Bennett, of Fairfield, in the county of Fairfield, and state of Connecticut, mariner, on oath declare, that I was mate of the sloop Concord, Hawkins Wheeler, master, in her late passage from New-York to Salem, Mass. that on Monday, the 6th day of June inst. at seven o'clock in the morning, I was on the deck of the sloop, sitting on the hatches—the vessel was steering N. W. and was then about eighteen miles from Race Point—the man at the helm made an outcry, and said there was something alongside that he wanted me to look at. I looked, and saw something on the larboard side of the vessel, about twelve rods, certainly not exceeding fourteen, from the vessel, that resembled a serpent or snake. I immediately arose and went to the side of the vessel, and took a position on the rough-tree, holding on by the shrouds; I there saw a serpent of an enormous size and uncommon appearance, upon the water; his head was about the length of the anchor stock above the surface of the water, viz. about seven feet. I looked at the anchor stock at the time, and formed my opinion by comparing the two objects. The weather was very clear and good, and the water almost calm; and I had, I think, as good a view of the animal as if I had been within two rods of him. The colour of the animal throughout, as far as could be seen, was black, and the surface appeared to be smooth, without scales—his head was about as long as a horse's and was a proper snake's head—there was a degree of flatness, with a slight hollow on the top of his head—the eyes were prominent, and stood out considerably from the surface, resembling in that respect the eyes of a toad, and were nearer to the mouth of the animal than to the back of the head. I had a full view of him for seven or eight minutes. He was moving in the same direction with the sloop, and about as fast. The back was composed of bunches about the size of a flour barrel, which were apparently about three feet apart—they appeared to be fixed, but might be occasioned by the motion of the animal, and looked like a string of casks or barrels tied together—the tail was not visible, but the part which could be seen was, I should judge, fifty feet in length—the motion of the bunches was undulatory, but the wake of his tail, which he evidently moved under water, showed a horizontal or sweeping motion, producing a wake as large as the vessel made. He turned his head two or three times slowly round, toward and from the vessel, as if taking a view of some object on board. I went up on the rigging, for the purpose of taking a view of him from above; but before I had reached my station, he sunk below the surface of the water, and did not appear again.

GERSHAM BENNETT.

Essex, ss. June 9th, 1819.—Then Gersham Bennett personally appeared and made oath that the foregoing affidavit by him subscribed, contains the truth, the whole truth, and nothing but the truth. Before me,

THEODORE EAMES, *Justice of the Peace.*

The substance of Pantopidan's account of the Serpens marinus Magnus, contained in his History of Norway, published in 1747, *(from a Boston Newspaper.)*

" The Serpens Marinus Magnus is a wonderful and terrible Sea monster, which deserves to be noticed by those who are curious to look into the works of the great Creator. It is usually in July and August he appears, and when it is calm"—" His head was more than two feet above the surface of the water and resembled that of a horse. Beside the head and neck, seven or eight folds or coils of the animal were distinctly seen, and were about a fathom apart." This is the statement of a Capt. De Ferry and others, who saw the serpent with him. The account from others, who are said to have seen this monster of the deep, states, that when it was calm, it lay on the water in many folds; and that there were in a line with the head some small parts of the back to be seen above the surface of the water when it moves or bends; and that at a distance these appear like so many casks or hogsheads, floating in a line, with a considerable distance between each of them. The historian adds, "that many other persons on the coast of Norway had seen the Sea Serpent—and thought it a strange question, when *seriously* asked, whether there were such an animal in existence; being as fully persuaded of the fact, as of the existence of an eel or cod."

Extract of a letter to the Editor, dated Boston, April 8, 1820.

I have lately received a letter from Sir Joseph Banks, written by his own hand,* in which he expresses his full faith, in the existence of our Serpent of the Sea, and not only as it regards himself, but his friends, and he is grateful for every new communication I have given him on that subject, and writes with the same enthusiasm that he did several years ago although he is now very infirm.

5. *Revue Encyclopédique &c.*

Mr. Julien of Paris, has favoured me with various published works of which he is either author or editor. Among these interesting productions I can now notice only one, and that briefly.

The "Revue Encyclopédique ou analyse Raisonnèe des productions les plus remarkables dans la literature, les sciences et les arts" published monthly, is a very able and interesting performance, concentrating in a good degree the intellectual light of the world, and marked by much impartiality

* Sir Joseph Banks, President of the Royal Society of London, the companion of Capt. Cook, is now *at a very* advanced age but still vigorous in his intellectual powers, and ardent in the promotion of every species of useful knowledge.—*Ed.*

and decorum, which appear to be effectually secured by the simple expedient of having the names of the authors attached to their respective pieces: this example is worthy of imitation and praise.—I trust I shall often draw on this work; at present my limits permit me to extract only a single article.

American Verd Antique Marble.

"*United States.*—An excellent quarry of Marble has been discovered in the vicinity of New-Haven, province (town) of Milford. A traveller in Connecticut pronounces this marble to belong to the beautiful species which is in Europe called *Verd Antique*, and which is found only in the palaces of the great, and in cabinets of natural history. Indeed, says this traveller, it surpasses in beauty all that I have seen of this kind. It is a great advantage that this quarry furnishes very large blocks, and that it is inexhaustible."

Mr. Brongniart of Paris, the celebrated mineralogist, in a letter now before me, speaking of the Milford Marble of which I sent him, among others, a polished specimen, says—"it forms one of the ornaments of my cabinet, and is referred with great precision to my Ophicalce Veinée,"* (or verd antique marble.) Some persons in this country confounding the *verd antique marble* with the *verd antique porphyry*, have denied to the Milford marble its proper rank: a rank which, truth requires me to say, has always been assigned it in the lectures here. It was discovered in 1811, by a member of the mineralogical class, while I was out with them on an excursion for instruction and observation. The farmers had made stone walls of it for almost two centuries, without suspecting what it was.

Professor Kidd of the University of Oxford, to whom I sent a specimen, and whose opinion I asked as to its geological character, says—"the serpentine would by some be referred to a transition series; by others to a primitive: but I am happy in thinking that the terms Primitive and Transition are daily becoming of less importance."

* Literally a veined serpentine limestone, and among the synonymes in Mr. Brongniart's treatise on the nomenclature of rocks, the ophicalce veinée is called Verd Antique.—*Ed.*

I purpose in a future number to give an account of the New-Haven and Milford Marble, which is equally interesting in its relations to the arts and to geology.—*Ed.*

6. *Miscellaneous Articles of Foreign Intelligence ; communicated by* Dr. J. W. Webster.

In France—The study of Organic remains continues to advance rapidly. Brongniart is at the head and is the most able man for Floetz (or secondary) formations, but for Primitive, Brochant is superior. Brongniart carries his views about coal formations so far, that he looks upon them as great Fresh Water deposits, from their sometimes containing shells like the lime or river water shells ; they are found for example at Entreveres, in the Alps, at Falkirk, and Alloa in Scotland, &c. On the other hand, following this step, Mineralogists have already shown the great aggregation of rolled flints and sand between the Jura and the Gres, to be a succession of fresh water and salt water depositions, or, at least three or four very different deposits ;—and the Jura limestone they have divided into three, limestone with Gryphites, and two others above which is the third Floetz limestone of Jameson.

Brongniart delineates and describes all the impressions of plants which he can get, and every lover of the Science must wish that he may be enabled to publish so fine a work.

Daubuisson has in the press, Elements of Geology in two vols. it will be a good work.

Humbolt is preparing a similar work.

Beudont, who has already, in the Journal des mines, given many interesting facts respecting the crystalization of salts under different circumstances, is about publishing a journey through Hungary, where he spent six months, and found beside primitive formations, a newer Sienitic and Volcanic Porphyry formation ; a red sand stone, with masses or beds of pitchstone, precisely like that of Arran, excepting that the latter occurs in veins ; a chalk formation, a part of the Paris formation, and a volcanic formation deposited and arranged in beds by water ; the pumice, in these singular watery arrangements having often, at first sight, the appearance of *chalk ;* his work will throw much light on Geology.

Dr. Maccullock's account of the Hebrides is nearly finished.*

Jameson's Philosophical Journal is much devoted to Mineralogy, and the numbers which have appeared do him great credit.

Heron de Villefosse has been enlarging his work, and his Geological Map of Saxony and the North of Germany is said to be very fine.

Berzelius has lately been at Paris and republished his new system.

Von Buch is busy with his work on Teneriffe in which many interesting discussions on Volcanic products will be introduced. The Baron lately dislocated his arm in leaping from a German stage coach.

Mr. Jameson has published his *New* system of Mineralogy, after the external characters *only*; but there are about thirty new substances, he has not mentioned: his Geology is not yet out.

Mr. Greenough is now the chief man of the Geological Society, and is preparing a Geological Map of England; but what shall we think of his late small work comprising the best observations of a Von Buch, Brongniart, &c. (with others of less weight) in which he expresses the opinion, that there is nothing constant in Geology, and that there is *no stratification* of rocks!

Bakewel is the principal *teacher* of Mineralogy in England.

Mr. Brocchi's work on the Appenines, and especially on the petrifactions, is fine.

Mr. Blainville's determination of the impression of fishes, in a periodical work, will be useful.

Specimens from China, the Cape, India and Senegal are now most prized in France, and many of much interest have been received.

At the Cape there is Mica Slate with granite veins. In Senegal much Iron stone, probably in a red sand stone formation.

Our Chromate of Iron is not likely to be much prized now, as Dr. Heber found plenty in the Shetland Islands, of which he is about publishing an account.

* Since published.—*Ed.*

7. *Curious fact respecting Animal Poison.**

It seems highly probable, that an infuriated serpent will secrete the poisonous fluid much more promptly than when in a placid state. And it is no doubt equally true, that many animals, which under ordinary circumstances are perfectly innoxious, become armed with a salivous poison when infuriated: a truly inexplicable phenomenon. Man himself becomes somewhat poisonous when highly excited by anger. Dr. S. Brown informed me that he has had patients under his care, who had been bitten in personal combats, and whose wounds exhibited every symptom of poison, pertinaciously resisting the ordinary modes of cure; but in these cases, the deleterious fluid is the saliva, (but it has been supposed that fragments of the tartar from the teeth remaining in the wound, were the cause of the apparent poison,) whereas in the serpent, as is well known, it is a peculiar secretion deposited in its proper recipient cavity.

8. *Map shewing the relative height of the principal Mountains on the Globe.*

Mr. Silliman—*Sir*,

I was sometime since very much gratified at seeing proposals of Mr. Timothy Swan, of Boston, for publishing by subscription, a Map† shewing the relative heights of all the principal mountains in the world. Having lately been in Boston, I called on Mr. S. and subscribed my name. The plate I was pleased to find nearly finished. As the work may not be known to many of your readers, allow me to call their attention to it. The engraving is beautiful as a picture, but to the mineralogist, and indeed to every inquiring mind, is exceedingly valuable, as it presents at one view the aspect and comparative heights of all the most celebrated mountains, the limits of perpetual snow, of vegetation, &c. The additions to the American edition are very numerous, comprising all our most elevated summits.—

* This fragment should have been inserted in Mr. Say's memoir on herpetology, but was accidentally omitted.

† The Map is about eighteen inches square.

From the appearance of the plate, there can be little doubt of the work being equal in point of execution to the English Map, while the additions will render it far more valuable to Americans. The publisher will, I trust, be remunerated by a very extensive and general subscription.

Yours, &c.

A. B.

9. *Cabinet of Minerals, for sale.*

We understand that a valuable collection of about twenty thousand specimens has been recently, and is still offered for sale. It comprises nearly all the varieties of simple minerals and numerous geological specimens; the minerals of Germany, Russia, France, England, Scotland, Ireland, Iceland, the Ferroe Isles and of the Azores, together with a complete series of the geology of Great Britain, of the London, Paris and Isle of Wight formations—a very extensive suite of Volcanic specimens—a geological suite of four hundred specimens, from granite to gravel, from Freyberg, together with a great variety of fossil remains, marbles, agates, &c. A series of models of crystals in wood, &c. The collection was formed by a gentleman in Europe, and has been pronounced second, (among American cabinets,) only to that at New-Haven. It is well worthy of the attention of colleges and universities. For further information enquire of Col. G. Gibbs, New-York; B. Silliman, New-Haven, and of Dr. J. W. Webster, Boston.

Remark.—This cabinet was advertised some time since in the newspapers, and an impression was received, by some persons, that it was Col. Gibbs' *collection.* It is sufficient to say that this was an error. Col. Gibbs' Cabinet is still in Yale-College, and has been, recently, (with his approbation of course) removed to a new and commodious room, fitted up for its reception, and sufficiently capacious to contain also the College Cabinet, and to receive an American one, which is forming, and the infant collection of the American Geological Society.

The room is eighty-four feet long by forty in width, and nearly twelve in height; it is finely lighted and exhibits the specimens in a very advantageous manner.—*Ed.*

10. *American Cinnabar and Native Lead.*

Extract of a letter from B. F. Stickney, Esq. *dated Port Lawrence, Michigan Territory, Mouth of the Miami of the Lakes, June* 17, 1819.

Remark.—In Vol. I. page 433, mention is made of American Cinnabar and native Lead. I have procured from Mr. Stickney, U. S. Agent, for Indian affairs a statement of facts relative to a subject, which, so far as regards the cinnabar, is so important, and as regards the native lead, is so curious, that I have not been willing to abridge the statement. Some of the mercurial sand which Mr. Stickney enclosed in his letter was unfortunately lost, so that I have never seen a specimen.—*Ed.*

Cinnabar.

It is true, that there is in this vicinity, a large district of country abounding with sulphuret of Mercury, more or less interspersed through the soil, in the state of a black and red cinnabarine sand, and in one place, the genuine red cinnabar occurs in the form of an impalpable powder or in small lumps and grains, interspersed in banks of clay. This is near the mouth of the Vermilion river, discharging itself into Lake Erie, about eighty miles south east of this place. From the mouth of the Vermilion, round the whole shore of the western end of Lake Erie, on the shores of Detroit river, Lakes St. Clair, Huron, and Michigan, the banks are streaked with small reefs of this black and red sand of Cinnabar. The whole body of the soil is interspersed with this sand through the whole of this extensive district of country. But generally it is more abundant in banks of fine ferruginous clay. When gentle breezes agitate the Lakes and wear away their banks, the water bears off the lighter particles of earth and leaves the heavy sand predominant, when it is found in great abundance. But after a violent storm, there is scarcely any to be seen ; for the great agitation of the whole sand of the shore, gives an opportunity to the ore of mercury, to find a lower level, in conformity to its much greater specific gravity.

Native Lead.

As the existence of native lead has been so much disputed, I will give you a full history of the circumstances that led to the discovery, and the evidence of its existence.

In the summer of 1812, a gentleman of unquestionable veracity, by the name of Johnston, a clerk in the store kept by the United States, for the purpose of Indian trade, at Fort Wayne, but not at all acquainted with mineralogy, told me that he, in company with five or six persons more, had found in the bed of the Anglaize river, near its mouth, a stone of uncommon appearance, and great specific gravity, and weighing thirteen pounds. The description which he gave of its colour and of the form of crystals, corresponded with galena; but he stated that there were some soft metallic spots, that might be cut with the same ease as lead, and had the appearance of that metal; that the stone was broken, and he and several others of the party took pieces of it. I desired to see the piece which he had; but upon search, found it to have been misplaced. About one year and a half since, a French lady, who was one of the party mentioned, related to me the same circumstances, and produced the piece she had preserved, weighing about five ounces, and answering the description that had been given. I found it to be a galena of the common lead colour, in very brilliant cubic crystals, inlaid in one direction with slips of perfectly metallic lead, about a line wide, and the sixth of a line thick, and the length extending across the piece of ore. I tried its fusibility by the blow pipe, and submitted it to tests.

I have sought in vain near the spot where it has been represented that this specimen was found to find more. I think it is probable there is a large mass farther up the river, that the piece found, was frozen into the ice, and floated down with it to the place where the ice thawed.

In conformity to your request, I have given you as full an account as in my power, of the sulphuret of Mercury and native lead.

11. *Means of Producing light, &c.*

Extract of a letter from Prof. Robert Hare, M. D. *of Philadelpia, to the Editor, dated Dec.* 30, 1819.

I believe I mentioned in a letter to you last summer, that I had rendered the flame of Hydrogen luminous like that of oil, by adding a small quantity of oil of turpentine to the usual mixture for generating that gas.* When the ingredients are at the proper temperature, the light is greater I think than that produced by Carburetted Hydrogen.

I have lately found that the addition of about $\frac{1}{17}$ of the same substance to alcohol will give this fluid the property of burning with a highly luminous flame, and that there is a certain point in the proportions at which the mixture burns without smoke like a gas light.

This observation may be of use where spirits are cheap, as in our western states, and even in the northern parts of the Union where it is made from potatoes.

It might be serviceable to morals if the value of this article could be enhanced by *a new* mode of consumption.

It is in my power to send you a drawing and engraving of what I call the caloriphorus, by analogy with Volta's Electrophorus. In this there is a self regulating reservoir of hydrogen on a better construction than Gay Lussac's, and the ignition is effected by a small calorimotor.

I have likewise an improved Eudiometer or gas metre.

A recurved tube with a capillary opening at the end of the crook is furnished at the other with a sliding rod graduated to two hundred parts. Being filled with water or mercury, the drawing out of the rod causes air proportionably to pass in, or if the point be previously within a bell glass holding gas, this will be drawn in.

I have five different forms applicable to the various reagents, used for analysis of gases.

The caloriphorus has a contrivance by which the hydrogen and oxygen may be exploded by the ignition of a wire instead of a spark, either in a common Eudiometer of Volta, or in that above described.

* This fact is mentioned by Mr. Morey also, in the present No.—*Ed.*

12. *Troy Lyceum.*

In November, 1818, "a few citizens of Troy who had attended Mr. Eaton's lectures on Botany and Geology," associated for mutual improvement in the various departments of natural history, and for the purpose of forming collections of specimens. This institution has been recently incorporated by the Legislature of New-York, and a lectureship created in it, which is now filled by Mr. Eaton. We understand that a considerable cabinet is already collected, and that many of the members of the institution are very active.

Established in a flourishing and opulent town, patronized by some of its most respectable and influential inhabitants, and having a very advantageous local position, it is believed that the Troy Lyceum, co-operating with the elder sister Lyceum of New-York, and with other similar institutions in our principal cities, will add to the stock of American science and do us honour.*

13. *Fibrous Sulphat of Barytes from Carlisle, thirty-four miles west of Albany.*

This Carlisle mineral was supposed by many to be sulphat of strontian. From my first seeing it, in July, 1818, I expressed the opinion that it was fibrous sulphat of barytes, (especially after finding its specific gravity to be 4·50,) of which variety I had a foreign specimen : and this opinion I confirmed by analysis in December following. Soon after, Dr. Torrey, of New-York, obtained the same result; and some months later, Prof. MacNeven.† I under-

* A communication containing extracts from the minutes of the Troy Lyceum, dated January 25th, 1819, was received, and would have been published, had it not been soon ascertained that one prominent subject of the communication, the fibrous mineral from Carlisle, was *in controversy*. My own opinion as to the nature of that mineral had been made up, before the receipt of the communication, and being different from that expressed therein, was duly transmitted to the Lyceum. Having received no intimation since, as to the ultimate opinion of that body, I have kept the communication on file.

It will be seen in a subsequent article, that the nature of the Carlisle mineral is now fully ascertained, and that I have extracted some facts relating to it and to other subjects from the Troy communication—*Edit.*

† Or his pupils under his direction.

derstand that Prof. Dewey was of the same opinion. In the mean time, Prof. Cooper, of Philadelphia, who at first believed the mineral to be sulphat of strontian, wrote me an account of experiments, which had induced him to change his opinion ; but it does not appear from his letter, or from Dr. MacNeven's mention of his own results in his atomic theory, that either of these gentlemen was acquainted with my opinion and analysis, which were communicated only to my classes, and by letters to a few friends ;* or with Dr. Torrey's analysis, read before the New-York Lyceum early in the present year. Prof. Hare writes me that he finds the mineral to be sulphat of barytes, so that now there is no difference of opinion respecting it.

In an extract from the minutes of the Troy Lyceum, forwarded to me by their Secretary, the following facts are stated on the authority of Mr. Eaton.

" The fibrous sulphat of barytes is found in the town of Carlisle, Schoharie county, about eight miles in a N. W. direction from the Court-house, three miles W. of the Schoharie Kill, three miles S. W. from Sloan's Village, and thirty-four miles W. of Albany.

It is in the N. E. face of a hill, which is about seventy or eighty feet high, and three-fourths of a mile in extent. The hill crosses the farms of Jacob Dickinson, Andrew Griffin, and Abraham Mosier.

Geological Position.—The fibres of the mineral are vertical, and in length from half an inch to two inches, standing between the layers of a soft argillaceous slate. By the lateral adhesion of the fibres, very extensive strata are formed. As fragments are found in the soil on the side of the hill through its whole extent, there can be little doubt that the strata of this mineral are as extensive as the hill itself. The rock in which it is imbedded is overlaid with compact limestone, which contains impressions of shells, mostly pectenites.

* I refrained from mentioning my opinion and experiments in this Journal, because I had and still have reason to believe that there is a real sulphat of strontian found farther west in the State of New-York, and thinking it possible that some of the gentlemen had confounded the two, I waited for further information.—*Edit.*

Uses.—Though the colour of the mineral is blue or bluish grey, the fragments which have for some time been exposed to air and light, assume an appearance in some degree resembling common borax. This induced Mr. Elias Baldwin, of the Society of Friends, an ingenious smith, to make an experiment with it in brazing, as a substitute for borax. His success encouraged him to apply it in various ways, until he found it to be the best flux ever used in brazing and welding.

By using it pulverized as a substitute for clay, he welded the most refractory steel with the same facility as if it were the softest of iron. He performed also the process of brazing several times, by which he proved its very great superiority to borax in two respects; its requiring a much smaller quantity, and its remaining more fixed in a high heat."

14. *Red Sand Stone formation of North-Carolina.*

Extract of a letter from Professor D. Olmstead, *of the College at Chapel-Hill, North-Carolina, dated Feb.* 26, 1820.

An extensive secondary formation has lately been discovered very near us. On the road between this place and Raleigh, travelling eastward, we come to it four miles from the College; but at another point it has been discovered within two miles of us. It is a sand stone formation. The varieties are the red and grey. I have traced it through the counties of Orange and Chatham, and have ascertained its breadth, between this and Raleigh, to be about seven miles. Its direction is a little west of south. If a line be drawn through the Richmond bason parallel to the great mountains west of us, it will pass through this formation. Hence, must we not regard this as a continuation of the great sand stone formation, which W. McClure has traced to the Rappahannock? Must we not consider the Richmond bason and this as forming parts of the same formation? The variety found nearest to this place is not unlike the old red sand stone found in your vicinity.

It was natural to look for coal here, and I have for some time directed the attention of my pupils, and of stone-cutters to this object. Two or three days since one of the latter brought me a handful of coal, found in this range, on Deep River, in Chatham county, about twenty miles south of this place. The coal is highly bituminous, and burns with a very clear and bright flame. It is reported that a sufficient quantity has already been found to afford an ample supply for the blacksmiths in the neighborhood.

It is my intention to employ the first leisure I can command in collecting more precise and extended information respecting the formation.

15. *Sidero-graphite.*

Extract of a letter from Dr. Torrey, *of New-York.*

I have just discovered a new mineral, or one which I cannot find described. It is a compound of *metallic* iron and plumbago. It somewhat resembles laminated plumbago. Its specific gravity is 5·114; is attracted by the magnet; *burns* when heated intensely, and *scintillates!* dissolves in great measure in diluted sulphuric acid, giving out much hydrogen gas. I have analysed a small piece, and found, *iron* 54·25, plumbago 11·50. I know of no such mineral, and I have called it *Sidero-graphite.* It is found at Schooley's mountain, N. J. but the exact locality is kept a secret by the person who found it, as the mineral is supposed to be something valuable! I shall soon, however, be able to procure two or three small specimens, and I will send you one.

16. *Fetid fluor Spar.*

Mr. Augustus E. Jessup, recently attached to the expedition up the Missouri, has visited the locality of fluor spar near Shawnee* town, Illinois, (Vid. vol. I. p. 52,) and finds this mineral very abundant and beautiful. He has observed, as he informed us, that this mineral is fetid by friction or percussion, and that even the fracture through a natural cleavage will diffuse the fetid odour around to the distance of two feet or more. We have repeated and confirmed Mr. Jessup's observation.

* Not far from the confluence of the Ohio and Missisippi.

17. *Effects of Cold.*

Dr. Lyman Foot, of the United States' Army at Plattsburgh, writes, "the thermometer has frequently stood here during the late winter at from 15° to 17° of Fah. below 0, in the morning, and at 10° and 12° below all day. It is amusing these cold nights to hear the ice on the lake crack; the report is like that of a six pounder, and the ice instantly opens to the width of ten or fifteen feet. What is the cause of it? Does ice contract on cooling below a certain temperature? The snow has been here four and five feet deep."

Remark.—Although in the act of congealing, and for eight or ten degrees above freezing, cooling water expands, there can be no doubt that when ice is once formed, it contracts by cold like other bodies. Hence the cracks and reports, always perceived even on narrow rivers, and on small lakes, during the prevalence of intense cold.* When this gradual contraction extends over a great surface, as on lake Champlain, we might well expect that the accumulated effect would produce very loud explosions, and very wide fissures; so wide as occasionally to swallow up, instantly, the unwary travellers who, with sleighs and horses, adventure by night, and sometimes even by day, upon the smooth surface of our great northern lakes. When the weather grows warm again before the ice melts, the fissures close and sometimes even overlap, owing obviously to expansion.—*Ed.*

18. *Stromnite—a new Mineral.*

From Dr. Th. S. Traill of Liverpool, we have received a printed paper read by him before the Royal Society of Edinburgh, April 20, 1817. It contains an able report of the characters &c. and composition, of a new mineral from Orkney, to which Dr. Traill has given the name of Stromnite. This mineral consists according to Dr. Traill's analysis, of carbonate of strontites 68·6—sulphate of barytes 27·5—carbonate of lime 2·6—oxid of iron 0·1 = 98·8 and the loss, of 1·2, in the 100, is attributed to water.

* These cracks are not to be confounded with those which, during the congelation, proceed from the opposite cause—namely, expansion; the space between the banks of rivers, small lakes, &c. not being wide enough to admit the expansion which the water suffers in freezing; the ice resisted by the shores necessarily cracks, and sometimes even cracks and overlaps.

19. *German Correspondent.*

We have perused, with pleasure, the first numbers of the German Correspondent, an occasional miscellaneous paper published in New-York, and devoted to German literature and science, with which it is the aim of the very respectable Editor to bring his countrymen better acquainted. The design is well worthy of encouragement, and the more so, as the Germans appear particularly well disposed towards the United States.

20. *Exploring Expedition.*

We are informed that Gov. Cass of Michigan, aided by D. B. Douglass of the corps of Engineers, one of the assistant Professors at the West Point Military Academy, and others, will proceed very soon, on an expedition along the southern and western shores of lake Superior, and through the district of country generally between lake Michigan and the Missisippi, and the head waters of that river. In connexion with negociations on Indian affairs, every practicable degree of attention will be bestowed on the natural resources of the country—on its mineralogy—botany, geography, &c. We anticipate from this source much valuable information.

21. *Mermaid.*

Extract from the log book of the ship Leonidas, sailing from New-York towards Havre, Asa Swift master ; May 1817. *Lat.* 44°, 6 *north.*

First part of the day light variable winds and cloudy ; at two P. M. on the larboard quarter, at the distance of about half the ship's length, saw a strange fish. Its lower parts were like a fish ; its belly was all white ; the top of the back brown, and there was the appearance of short hair as far as the top of its head. From the breast upwards, it had a near resemblance to a human being and looked upon the observers very earnestly ; as it was but a short distance from the ship, all the afternoon, we had a good opportunity to observe its motions and shape. No one on board ever saw the like fish, before ; all believe it to be a Mermaid.

The second mate Mr. Stevens, an intelligent young man, told me the face was nearly white, and exactly like that of a human person; that its arms were about half as long as his, with hands resembling his own; that it stood erect out of the water about two feet, looking at the ship and sails with great earnestness. It would remain in this attitude, close along side, ten or fifteen minutes at a time, and then dive and appear on the other side. It remained around them about six hours. Mr. Stevens also stated that its hair was black on the head and exactly resembled a man's; that below the arms, it was a perfect fish in form, and that the whole length from the head to the tail about five feet.

Communicated by Mr. Elisha Lewis of New-Haven, a respectable merchant.

22. *Bubbles blown in melted Rosin.*

The following curious fact is mentioned in a letter to the Editor, from Mr. Samuel Morey, of Orford, N. H.:—

If the end of a copper tube (a pipe stem will answer,) be dipped in melted rosin, at a temperature a little above that of boiling water, taken out and held nearly in a verticular position, and blown through, bubbles will be formed of all possible sizes, from that of a hen's egg to those which can hardly be discerned by the naked eye; and from their silvery lustre, and reflection of the different rays of light, they have a pleasing appearance. Some that have been formed these eight months, are as perfect and entire as when first made. They generally assume the form of a string of beads, many of them perfectly regular, and connected by a very fine fibre—but the production is never twice alike. If filled with hydrogen gas, they would probably occupy the upper part of the room.

In a letter to Mr. Morey, the Editor attributed the *formation* of these bubbles to the common cause, viz. the distension of a viscous fluid by one that is aeriform; and their *permanency* to the sudden congelation of the rosin, thus imprisoning the air by a thin film of solid matter, and preventing its escape.

The temperature at which the bubbles are formed, being very low, even this very thin rosinous globe, might be strong enough to resist the small atmospheric pressure arising from the condensation of the included air by cooling.

In a letter, dated March 28th, 1820, Mr. Morey replies: "The cause you assign for the permanent formation of the rosin bubbles is undoubtedly correct. A little girl came running to me one evening, with, as she said, about two thirds of a string she had formed from the rosin of one of the stove lamps, while burning. It consisted of twenty-two or twenty-three beads, each about one third of an inch long and one fourth of an inch in diameter, connected together by a fine fibre, less than one eighth of an inch long. In passing my eye repeatedly from one end to the other, I could not discover any difference in their length, form, or size, or in the distance they were apart, except two or three at one end. Considering that the temperature of the rosin, and the materials, and the pressure are always the same, I have no idea what governs the formation of the bead different from that of the fibre. When I mentioned it to you, I did not suppose it was new, and if so, I thought it very uncertain whether you would think it worth noticing in the Journal.

23. *Effect of temperature on human feeling.*

Professor Olmstead, in a letter to the Editor, remarks: "In England, the only natural temperature that is agreeable, lies between 60 and 70°, so that when the thermometer is above 70, the inhabitants begin to feel uncomfortably warm, and when it is below 60, they begin to approach the fire. In this climate, (lat. 35, 40, N. long. 79, 3, W.) we do not feel uncomfortably warm until the thermometer is above 80; and we begin to kindle fires when it is below 70. It would seem therefore that our standard in this respect is 10° higher than it is in England; and that we do not suffer more by a heat of 90, than the people of England do by a heat of 80. Dr. Black also remarks, that, in Scotland, the thermometer rises, in moderately warm summer air, to 64°. According to this account, what would be esteemed moderately warm summer weather in Scotland, would be considered cool autumnal weather in this climate, when the presence of a fire would be quite comfortable, and almost necessary. It seems moreover agreeable to the analogy of nature, that the animal system should accommodate itself, in some measure, to the external circumstances in which it is placed.

N. B.—Many more small articles, localities of minerals, notices of books, discoveries, &c. are necessarily postponed.—*Ed.*

THE

AMERICAN

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GEOLOGY, MINERALOGY, AND TOPOGRAPHY.

Art. I. *Account of the Geology, Mineralogy, Scenery, &c. of the secondary region of New-York and New-Jersey, and the adjacent regions; by* James Pierce.

THE secondary region of New-Jersey and of New-York situated West of the river Hudson and southeasterly of the Highlands extends from North to South about sixty miles, with an average breadth of thirty. It exhibits an interesting diversity of surface, embracing fresh and salt water alluvial, extensive valleys and plains, alternating with mountain ranges of considerable elevation; and among a variety of interesting minerals peculiar to secondary regions, this tract presents many of great utility, and inexhaustible in quantity.

On the eastern border of the abovementioned secondary region and adjacent to the Hudson, is observed a prominent mountainous range. This elevation rises gradually from Bergen point, and pursues for sixty miles, a nearly uninterrupted course, terminating near the Highlands. In the State of New-Jersey, it has an average width of two and a half miles, with a summit of table land; from its western brow there is a gradual descent to the alluvial valley of the Hackensack and Passaic; on the eastern side it is uniformly either steep or precipitous. At Wehawk, four miles North of the city of Jersey the mountain presents a perpendicular wall of about 200 feet elevation above the Hudson; from this summit an extensive prospect appears, of the harbour of New-York, of a diversified country, and of works of art exhibited in a great city contrasted with the adjacent wood-clad rocky mountains, where nature appears in her rudest state.

From Wehawk to Fort Lee an alternation of precipitous ledges and steep declivities is seen, mostly clothed with trees of varied verdure, but frequently displaying a rocky surface ; the hills retiring here and there give place for narrow but fertile and well cultivated strips of ground upon which many neat dwellings appear, environed by fruit-trees and diversified crops, which are seen to advantage in contrast with the rocky eminence in the back-ground. From Fort Lee to the vicinity of Tappan, a distance of sixteen miles, the mountain presents a great uniformity of aspect—on its eastern face bordering on the summit, is seen an extensive unusual precipice called the Palisadoes of near 200 feet perpendicular altitude ; numerous vertical fissures are observed in the rock, crossing each other at various angles, forming columns of basaltic appearance. The face of this ledge is in general divested of verdure, but it is here and there seen in the crevices. The direction of the Palisado mountain is parallel with the river and is nearly North and South ;—the face of the ledge is slightly waving. From the base of this precipice to the river's border, a distance of from three to four hundred feet, a steep declivity is seen covered by angular blocks of stone fallen from the Palisadoes—this part is shaded by trees and bushes. The summit of the Palisado mountain presents a surface of slightly undulating table land that gradually rises to the north, its average width about two miles. It is mostly a wood-clad tract, as uncultivated as the Indian wilds. The western side of the mountain is of gradual descent, cleared and rendered productive ; neat sandstone farm-houses range near the base of the hill for twenty miles like a continued village. From the western brow of this ridge is seen an interesting variety of mountain ranges, rich, highly cultivated valleys, and extensive alluvial meadows through which the Hackensack and its auxiliary streams pursue their course.

The minerals of this mountain-range from Bergen Point to its termination, are of a pretty uniform character. Coarse secondary greenstone, an aggregate of hornblende, feldspar and epidote, is exclusively the summit rock in place. The feldspar cannot readily be distinguished from quartz in a newly broken specimen of this stone as from irregular crystalization it does not present the fracture characteristic of feldspar, but where the surface has been long exposed to the air, the feldspar whitened by commencing decomposition, is apparent. The summit rock of the Palisado range is not so dark as the greenstone of New-Haven, having less hornblende but otherwise agreeing in external character and geological relations.

The only interesting crystalized mineral associated with the greenstone of this range is prehnite. I have recently discovered good specimens of that mineral in ledges of fine grained greenstone that border the eastern shore of Newark bay—for several miles, masses of radiated prehnite of a lightish green were of frequent occurrence, some of them a foot in diameter. I found at this place a detached specimen of compact prehnite five inches in thickness, weighing six pounds—it was ascertained by Dr. Torrey to possess the uncommon specific gravity of 3145. Coarse greenstone in place is observed within a short distance of Bergen point—it forms the nucleus of hills of considerable elevation five miles below the village of Bergen. Mural precipices of coarse greenstone, gradually diminishing in altitude border the eastern section of the peninsula to within half a mile of the narrow sound that separates New-Jersey from Staten-Island. In these precipices I have noticed crystalized feldspar filling fissures half a foot in breadth. In the vicinity of Wehawk, on the eastern face of the mountain, greenstone of a dark color and fine grain, in which hornblende greatly predominates is often observed. In this neighbourhood I have recently discovered a mineral approaching the character of kaolin ; it is pulverulent, and of a grayish white, and does not form a paste with water. It was found by Dr. Torrey to whiten and fuse when exposed to heat ; it appears to be a suitable material for the manufacture of porcelain ; it is associated with a secondary disintegrating rock of quartz and decomposing feldspar ; the kaolin originates from this last mentioned mineral ; this rock is in various stages of decomposition, is several feet in thickness and lies under greenstone. At the base of the mountain bordering the river, in many places, secondary argillaceous shist, conglomerate, red, white, yellow and purple sandstone, and indurated clay alternate, exhibiting a stratification nearly horizontal, the underlying inclination being from 8 to 10 deg. These layers are sometimes seen on the mountain's side at considerable elevations above the river. The sandstone abovementioned is in general a coarse aggregate of quartz and feldspar, often friable but sometimes very firmly combined, exhibiting winding vertical fissures. A fine compact white sandstone, resembling the Portland stone of England, is noticed in a few places as the basis layer of the Palisadoes. The compact white sandstone is in repute for cellar walls, not absorbing moisture as readily as the red freestone. The greenstone of the Palisadoes is much used in forming docks; it is rarely found in a decomposing state.

A metallic vein was worked at Fort Lee at the commencement of the revolutionary war under the impression that it contained gold. Doct. Torrey has ascertained that the ore is pyritous and green carbonate of copper, the matrix quartz and a silicious and calcareous breccia dipping under greenstone. In the breccia numerous cavities of a regular rhombic form are observed—they were doubtless occupied by rhombic chrystals of calcareous spar as that description of carbonate of lime is seen at this place imbedded and detached. Micaceous oxide of iron is found in most specimens containing pyrites.

The trees commonly met with on the above described range, are different species of oak, walnut, chestnut, maple, butternut, birch, gum, cedar, &c. The neighbourhood of Fort Lee and many parts of the mountain is heavily timbered.—Of berries the blackberry, whortleberry, raspberry and strawberry are abundant.

The wild animals occupying these heights with almost exclusive dominion, are the wild-cat, raccoon, fox, opossum, rabbit and squirrel.—The poultry yards at the western base of the mountain are often annoyed by the fox and opossum. Of venomous serpents the copper-head is the most common, but the rattlesnake is sometimes seen on the Palisado range. Eagles and hawks are numerous—they build their nests securely on the mountain cliffs.

The elevation of the several points of the Palisado range was ascertained by Capt. Partridge to be as follows.—Fort Lee, 311 feet above the bed of the river;—the bluff opposite Spiten-Devil, 407;—a height a little farther North, but rising above the general level, 479;—Bompay Hook, two miles above Closter landing, 517;—bluff North of Bompay Hook, 549;—Closter mountain near Rock-land County, 539.

I observed at several places on the summit of the Palisadoes, large projecting columns of greenstone, with from four to six well defined sides and in one or two instances nearly regular hexahedral prisms eight or ten feet in diameter, apparently extending to the base of the precipice and retaining for a considerable distance their basaltiform aspect.

At the termination of the Palisadoes, Tappan sea, an expansion of the Hudson commences and extends northerly ten miles with an average breadth of four. A clove passage through which winds Tappan creek, separates the Palisado table land from a mountain range that gradually rises north; this chain has for four miles at its base the waters of Tappan sea; the eastern side seldom exhibits precipices; it is in many places elevated and cultivated—but the summit displaying irregular elevations is generally crowned with wood. Greenstone in no way differing from the rock of the Palisadoes is exclusively the summit rock in place. The western side of the mountain is in general steep, rocky and wood-clad. Adjacent to Tappan creek an excavation is seen extending horizontally into the greenstone rock of the mountain about 1000 feet, made in searching for silver, but the vein was not found sufficiently good to be worth pursuing. Red sandstone is extensively quarried on the eastern side of the mountain at various elevations.

The northwestern part of Tappan sea is bounded by ground rising gradually for two miles. The surface is every where underlayed by red sandstone of a fine grain but soft, porous, and absorbs moisture more readily than the freestone of the Passaic to which it is in general inferior in quality. In this tract is situated the small village of Nyack. Land bordering Tappan sea, that embraces good quarries of freestone is valued at 1500 dollars the acre.—The mountain chain ranges in the back ground to the northwest of Nyack, presenting moderate elevations—it then sweeps forward to the east bounding Tappan sea on its northern side to Kedidika Hook; it there takes a northwest direction parallel with the river for four miles, rising abruptly from the water to a great height; its ledges in many places precipitous are composed of the materials observed in the Palisado rock, with the addition in some parts of the summit of a little sulphur rendering it friable. The mountain is underlaid by sandstone, marking its secondary origin. At Haverstraw the chain rises to its greatest height, presenting numerous ledges and irregular elevations. The most lofty peak called High Tower situated near Haverstraw landing, was found by Capt. Partridge to rise 850 feet above the bed of the Hudson; a wall of rock of some hundred feet perpendicular height borders the summit. Sandstone in place is found on the side and at the base of the mountain. Piles of dark angular blocks of greenstone in many places occupy the sides of the mountain to the exclusion of vegetation. Puddingstone, containing smooth round pebbles is frequently observed. From Haverstraw the greenstone mountain ranges in a western course and sweeps with a diminished height to the vicinity of the Highlands, presenting to the eye a profile of wild and irregular eminences. Iron is abundant in this western chain; veins of this ore of the best quality have been found in several places running from the North-River to the Highlands. The quality of many beds rich in iron is injured by sulphur. A manufacture of copperas from the sulphuret of iron met with in this section of Rockland county was once contemplated. Rich copper ore has been found not far from High Tower, but the traces of it are lost. On the southern side of the mountain running west from Haverstraw, the descent is in general gradual; much of the surface is cleared and cultivated and of a medium soil, well watered by numerous springs; large rolled masses of granite and gneiss rest on the mountain side, probably conveyed to this secondary region from the Highlands by some convulsion of nature.—Pectanites and other marine petrifactions have been found on this ridge at considerable elevations; fine grained trap is met with at the base.

Westward of the Kedidica Hook range, and half a mile from the Hudson is situated a mountain lake four miles in circumference, called Rockland lake;—its surface is 150 feet above the bed of the river from which it is separated by a lofty ridge—the land elsewhere adjacent to the lake, rises gradually, is of a good soil and well cultivated; several neat stone farm-houses are pleasantly situated on the banks of this extensive sheet of water. The lake is well stored with pike, yellow-bass, perch, sunfish, and suckers, but there are few eels, and no catfish are found. No stream of magnitude is seen to enter the lake, but it is the source of one of the most considerable branches of the Hackensack. Fed from below by mountain springs, it retains a greater uniformity of temperature and altitude than is observed in ponds formed by the expansion of a river in a valley; it seldom rises two feet in height, and remains unfrozen after the North-River is closed; this must be attributed to its great depth and the warmth of its auxilary streams. Condensed by cold, the fluid on the lake's surface descends, and its place is supplied by warmer water from below; an interchange continues as is well known from the experiments of Count Rumford and others, until the mass is reduced within eight degrees of freezing point, when being no longer condensible by cold it remains stationary and the surface is frozen. Ice being an indifferent conductor of heat the fluid below continues much warmer than the air. The waters of the lake are soft and pure and as they repose on a sandy bottom, no water-weeds or swamps are seen on its borders except at the river's outlet. The adjacent inhabitants are not subject to the fevers and early fogs of autumn; the waters of the lake remaining colder than the air, morning exhalations do not arise to be condensed. Vegetation bordering on the lake is seldom injured by premature frosts; being protected probably by the then warmer air of the water. The height of that part of the Kedidica Hook range situated between the lake and the river, is 640 feet above tide water, as calculated by Capt. Partridge. To Joseph Dederer Esq. a well informed resident of the northern bank of the lake, at whose pleasant and hospitable mansion I have passed many days, I am indebted for much local information.

The elevation of Kedidica Hook is well calculated for geological and geographical survey, uniting extension with distinctness of view. The wood-clad Highland chain is observed ranging the horizon for fifty miles; its course is from northeast to southwest; the Newark and Prucknes mountains faintly appear to the southwest. The Haverstraw mountain is near you, with its camel's back summit running westwardly; to the South the Palisadoes are seen. In the immense valley embraced by these mountain ranges, the hills and plains, the cultivated and wood-clad tracts, the lakes and streams are viewed upon the uneven map of nature; the greater part of this valley appeared in a good state of cultivation. To the southwest of Tappan sea in the direction of Hackensack and Pyramus, the country is in general very level and inclining to sand, and well adapted for the use of gypsum, but this valuable manure is seldom used by the farmers of this district; sandstone predominates in that tract. To the West of Kedidica Hook the surface is more uneven and hills of considerable elevation are seen adjacent to the Highlands mostly under cultivation. The Hudson at your feet with its expanse of waters and numerous bays, is seen for a great distance; its primitive eastern bank rising gradually to mountain elevations is thickly settled and most of the summits cleared. From Haverstraw to Stoney-Point, a distance of five miles, and from Haverstraw bay to the Highlands, in a northwest direction the country is in general level, the soil inclining to sand is in many places underlaid by red sandstone. Good whetstones have been recently quarried in this part of the country.

The summit of Stoney-Point, once a distinguished military post, exhibits in place rocks composed of green feldspar mottled with black mica, the feldspar however predominating; a slight effervescence is produced by acids. On the North side of this eminence a mineral is found which appears to be composed of iron, alumine, silex and some magnesia; it occupies the mountain's side and large blocks detached are observed on the shore—it has the aspect of an ore of iron. This ferruginous rock embraces in veins a mineral containing much magnesia; it is translucent at the edges, the lustre waxy, the fracture splintery with a dark green, unctuous surface, answering pretty well to the description of splintery serpentine; its surface is dissolved by diluted sulphuric acid, and epsom salts formed in numerous crystals; this effect is not produced upon any other description of serpentine that I have elsewhere met with. The peninsular situation and difficult ascent of Stoney-Point rendered it an admirable situation for a military post. At the base of the mountain fine grained micaceous shist appears. At Stoney-Point commences the primitive region. White granular limestone is abundant in the ranges of hills to the West and North of Stoney-Point; it is a continuation of the rock of the same character that passes through New-England, and is in great quantity near Verplank's point.—The country North of Stoney Point, adjacent to the river, and extending half the distance to the Highlands is hilly and rocky, and not extensively cleared; for two miles, the remainder of the distance, the North river running from the northeast, washes the base of a wood-clad tract that may be considered as making a part of the Highland chain; numerous streams descend the winding glens of the mountain.

Rockland County is of a triangular form; the inhabitants are mostly of Dutch descent; Dutch continues to be generally spoken—many families have not acquired the English language. The Dutch of Rockland county have deservedly acquired the character of being hospitable. This county includes within its limits the first ranges of the Highland chain; from Rockland they cross New-Jersey and extend to the Delaware, bounding the secondary region.

Two prominent mountain ranges running near each other intersect the interior of the secondary region of New-Jersey. They take their rise adjacent to the primitive Highlands two miles North of Pompton and run about eighty miles an almost uninterrupted semicircular course. The summit rock in place is uniformly a dark colored, fine grained secondary greenstone, resembling basalt; it is frequently observed resting on conglomerate and sandstone—these rocks are supposed to lie under most of the greenstone ranges of New-Jersey; the most elevated point of these mountains is situated six miles northwest of Patterson, where a sugar-loaf peak rises near 1000 feet above the level of the ocean. Its trap rocks are generally covered by a thin mould that exhibits a verdant surface, and a walnut grove without underbrush, exclusively occupies the summit for an extent of forty acres. This elevation commands a diversified and extensive view; to the East, northeast and North the eye ranges over a great extent of pretty level country. The waving summits of the Prackness ridge are observed extending in a northwest direction for several miles, with ponds of magnitude and depth. A detached mountain range of considerable elevation is situated north of the Prackness ridge; it sweeps in a semicircular course several miles, taking its rise and termination near the Highlands. Many of the summits are under cultivation and afford fine views of the immense secondary valley situated between the Highlands, the Hudson and the Prackness ridge. Greenstone of a fine grain is the rock in place, in which I found prehnite and stilbite imbedded. To the East of the Prackness ridge is situated another section of the extensive greenstone ranges called the Totoway mountain—this ridge rises near the Prackness mountain six miles from Patterson, and connects itself with the Newark chain at the great falls; it is in many places free from rocks, but on the East, precipices of considerable extent and height with waving or denticulated mural faces are sometimes observed, presenting columns approaching to basaltic regularity. An insulated semicircular wall of greenstone, with projecting columns occupies a summit of the Totoway ridge, bearing some resemblance to a castle or fort in ruins. Sandstone quarries are observed in several places at the base of the greenstone ridges. A quarry situated three miles northwest of Patterson, at the Prackness mountain affords the best freestone of New-Jersey. Fine red and gray sandstone embracing some mica, alternates with argillaceous strata, dipping under the greenstone with a western inclination of about 12 degrees. Bituminous coal, in layers of about two inches in thickness has been frequently found at this and other parts of the Prackness ridge, in connection with sandstone and shale. This neighbourhood exhibits many indications that more valuable beds of this combustible exists below. Gneiss, granite, pudding and sandstone, in rolled masses, appear abundant on the surface in many parts of this region. The greenstone of the Prackness range rarely presents interesting imbedded minerals. I have however found, in a few places, prehnite, agate, chalcedony, and a mineral answering to the description of cacholong. At the falls of the Passaic near Patterson, perpendicular mural precipices of greenstone, with wide vertical fissures are observed, and amorphous masses at the base. The lower strata of this rock contain much argillaceous matter, which partially takes the place of hornblende. The ledges at Patterson rest on a porous rock that lies in a horizontal position resembling the toad stone of Derbyshire. Carbonate of lime and other minerals subject to decay are imbedded in the rock ; numerous cavities, left by their decomposition, give a volcanic aspect to the strata. A friable amygdaloid with an argillaceous basis was observed in several places, embracing numerous nodules of carbonate of lime of a spheroidal, oval or almond shape, from the size of a pea to that of a walnut ; they are easily disengaged from the base, and exhibit a smooth dark green surface ascertained by Dr. Torrey to be chlorite.—The layers beneath the amygdaloid are red and gray conglomerate connected with red sandstone, too porous for use, as it absorbs much moisture and is broken by the expansive power of frost. Good freestone, in nearly horizontal position, is the basis layer and forms the bed of the Passaic. In many places the greenstone occupying the summit appears but a few feet in thickness. The greenstone of Patterson does not present columns assimilating to basaltiform regularity. On the bank of the Passaic, adjacent to the first manufactories, I observed a well defined hexaedral column of fine grained greenstone, a loose mass, about five feet in length by two in diameter ; by the aid of a magnifier its greenstone composition is apparent. Before the autumn of 1818, prehnite, calcareous spar, and carbonate of copper were the only minerals observed imbedded in the greenstone ranges adjacent to Patterson—at that period I met with, near the falls, superior specimens of zeolite, stilbite, analcime, and datholite, together with fine masses of prehnite ; amethyst has been since discovered by Judge Kinsey, and Mr. J. I. Foote, residents of Patterson—to these gentlemen I am indebted for many useful facts. Prehnite I obtained in translucent masses of considerable size, some specimens three inches in thickness ; the fibres often radiate from a common centre, a mammelated surface is frequently observed, considerable lustre is reflected from narrow polished planes ; the colour in general a delicate light apple green, but in some specimens it is darker than the emerald.—It is found imbedded in greenstone at the falls.

The zeolite of Patterson is white, aggregated in fascicular groups of delicate diverging fibres, and presenting detached acicular four-sided prisms of various dimensions, sometimes diverging from a point, but often radiating from a centre; with nitric acid it forms a jelly. Stilbite I found associated with prehnite, in distinct well defined crystals, sometimes in irregular groups, but often insulated. The crystaline form may be described either as a flat four-sided rectangular prism, acuminated by four planes set on the lateral edges, or as an elongated, six-sided table, bevelled on four of its lesser sides—the sides are proportioned as two is to five, the colour white with pearly lustre; the structure is laminated; it is translucent, softer than prehnite, and does not form a jelly with acids. Since my discovery of datholite at Patterson, I have sought in vain for this mineral elsewhere in the greenstone ranges; the vicinity of the falls is the only locality for it yet found in this country—and there is but one in Europe;—its character was conjectured by Col. Gibbs and ascertained by Dr. Torry by analysis. The Patterson datholite will probably be regarded as a new variety of the Norwegian mineral, differing in crystaline form and proportion of constituent parts. The above mentioned minerals are generally found connected with an amygdaloid that embraces considerable green earth.

Mural precipices of dark fine grained fissile greenstone are observed at the little falls of the Passaic, five miles from Patterson—numerous vertical seams cross each other at various angles in the ledges, giving to many detached pieces a regular prismatic form with three and four sides, often truncated on one or more of the lateral edges; a tabular form is common. Rock of similar character was often observed in other parts of the Pracknes ridge. Organic remains from the ocean, or petrifactions of orthocerites, madrepores, tubipores, pectinites, terebratulas, encrinites, bilabites, serpulites, and other species, generally in an argillaceous base, resting on mountain and valley, I have found in the vicinity of Patterson, and in many parts of the secondary region of New-Jersey.

The situation of Patterson is admirably adapted for a manufacturing town—it is within four miles of sloop navigation upon a never failing stream, that furnishes water power sufficient for two hundred mills, and mill-seats without end; fuel is abundant and the market can be well supplied from the beautiful and fertile valley through which winds the Passaic. The streams auxiliary to this river embrace the waters that for near one hundred miles of their course descend eastward from the primitive mountains; many of these streams have their origin from extensive lakes and run forty miles in mountainous districts.

From Patterson to Springfield the trap ridges are called first and second Newark mountain and Caldwell mountain; their direction is nearly south, preserving a great uniformity of altitude—as seen from New-York they mark an even line on the western horizon—the eastern side is steep, the western of gradual descent, a description applicable to most of the mountains of New-York and New-Jersey—it is observable at the alluvial Highlands of Neversink, the primitive mountains of Staten-Island and New-Jersey, the green hills of Long-Island, at the Palisado and at the Shawangunk and Kattskill mountains. Secondary greenstone of a uniform character, no way differing from that at Passaic falls is the only summit rock, in place, observed on the first and second Newark mountain, but except in the vicinity of Patterson and Springfield, mural precipices are seldom seen. The mountains side is, wherever ledges appear, covered with small amphorous stones—red sandstone is observed in place on the sides and at the base and is supposed to lie under the Newark ranges. The eastern side of the mountain is much of it cultivated to a considerable height; the soil is red from the disintegration of sandstone; the summit and western declivity is in general occupied by coppice, of small oak, chestnut, walnut, butternut and cedars. The second Newark mountain running a parallel course and distant about a mile from the first is less elevated and rocky and the ascent more gradual than the first; I have found prehnite and agate imbedded in the rock of this mountain. The eastern view from the first Newark mountain is diversified and particularly pleasing in spring; at the base of the mountain is presented an extensive, rich, thickly settled and highly cultivated valley that appears from the summit to be a nearly level plain—the meadows and fields of grain present a beautiful light verdure and innumerable orchards are gay with blossoms; the villages of Bloomfield, North and South Orange, and the large towns of Newark and Elizabethtown are in view—you overlook the extensive alluvial meadows of Newark and have a full view of the city and harbour of New-York, a part of Long-Island and Staten-Island and a distant view of the ocean.

The valley situated between the Newark mountain and the Bergen greenstone ridge is partly secondary, the rest alluvial. In the secondary division, sandstone in nearly horizontal position, or waving with the surface is found almost every where on penetrating the earth—and fine red and gray freestone alternates with shale at the sandstone quarries of the Passaic and Second river. Bituminous coal in thin layers has been noticed, associated with argillaceous shale in many freestone quarries adjacent to the Passaic; at the termination of the Newark mountain, at Springfield and at many parts of the trap ranges, smoke, and in some instances flame issuing from the crevices of the rocks has been noticed by the adjacent inhabitants—as no pyrites has been observed, these phenomena probably proceed from carburetted hydrogen gas, indicating coal below,—that mineral being often found under secondary trap and sandstone. Animal and vegetable organic remains have been observed imbedded in the freestone of New-Jersey—near Belville a tooth near two inches in length was recently found on the freestone fifteen feet below the surface.—Copper is observed in many partsof the New-Jersey secondary region; a vein of ore affording eight per cent of copper has been recently discovered near the Passaic three miles north of Bellville; the vein is now lost.—A rich mine was formerly worked on the property of Col. Schuyler a mile east of Belville, but the draining of the shafts becoming too expensive, the works were relinquished. The matrix of the ore is gray and red sandstone, often accompanied by an argillaceous and calcareous breccia; the sulphuret, azure and green carbonate of copper and red oxide of copper are here found, but no pyritous copper. I have procured at this place good specimens of the fibrous malachite; the crystaline fibres are collected in groups diverging from a point—the colour is emerald green with silky lustre—tufts are seen composed of short fibres resembling green velvet. Carbonate of Lime in the crystaline form of dog-tooth spar, and filling veins is often here observed. This place is reported as a locality for oxide of titanium, but the only specimen found here was in a small solid mass of quartz. Not far from Aquackinock there is a copious mineral spring; its waters contain carbonic acid, iron and muriate of soda. The Newark mountain terminates at Springfield—from this place where the continuity of the trap range is broken, the greenstone ridge takes a southwest direction for ten miles and then a west course ten more, from thence it bends to the northwest, terminating near Pluckamin—adjacent to this range a mountain is seen running a parallel course, corresponding to the second Newark mountain. Secondary greenstone is exclusively the rock in place of the summits and sides of both ranges ; it is frequently observed, but seldom in ledges of magnitude ; sandstone is quarried in various places between the hills and at their base ; it is observed in several instances under the greenstone in a nearly horizontal position with a small dip, sometimes alternating with secondary compact limestone, that presents layers of from two inches to two feet in thickness. Prehnite is found in considerable quantities near the foot of the mountain in amygdaloid with a greenstone base, much of it partially decomposed ; it is sometimes seen imbedded in the rock in long parallel columns of various dimensions, its fibres radiating from the centre. Zeolite, stilbite, crystals of quartz, and carbonate of lime were frequently seen in the valley between the mountains. North of Scotch plains I found sulphate of barytes associated with carbonate of lime ; but a small portion of these ranges is cleared and cultivated. The secondary mountain that takes a western course from Springfield, bordering the alluvial, has been called by some geologists the Granite-Ridge. It is described as passing through New-Jersey, bordering the oceanic alluvial, whose highest point is seen near Hoboken, alluding doubtless to the height near Wehawk. The *Greenstone-Ridge*, would be a more appropriate name. Excepting the serpentine at Hoboken there are no primitive rocks in place between the Hudson and Highland chain—the summit rock of all the ranges is uniformly secondary greenstone. The secondary mountains of New-Jersey can, at a great distance, be distinguished from primitive by the regularity of their course and the aspect of their summits. The Highland chain runs from northeast to southwest which is the general direction of the primitive strata of mountains and vallies yet observed in the United States ; none of the secondary ranges of New-Jersey pursue a course parallel with the primitive. The secondary ranges of New-Jersey, in many places present for miles an even summit of table land; the Highland ridges display numerous sugar-loaf eminences, and a waving profile, characteristic of primitive. The extensive secondary range commencing near Pompton and within half a mile of the Highlands and extending in a semi-circular course, until it again approaches the Highlands, exhibits in its direction and the aspect of its summits a proof of the correctness of the above positions. The extensive valley situated between the greenstone semi-circle and the Highlands presents much fresh water alluvial—many of the small hills of this tract have no rock in place—the alluvial plain bordering the Passaic is in general extensive; in some places four miles in width—peat is observed in several places between the source of that river and the little falls; a considerable quantity is cut in this valley adjacent to the Newark and Morriston turnpike; the earth had been penetrated six feet without finding the bottom of the strata. The level tract called Pompton plain near twenty miles in circumference and environed by mountains presents a decided fresh water alluvial—strata of gravel, sand, and clay, without rocks in place are uniformly found in this district wherever wells have been dug; it was probably at a remote period the bed of a lake.—The waters of the rivers Pequanack, Long-pond, and Ramapaugh pass through this valley—the southern and much of the western part of Pompton plain is marshy and embraces about 1500 acres of peat ground; the peat disclosed in digging a ditch of four miles was called very good. In the southern part of the plain good granular argillaceous oxide of iron or pea ore is raised from a space of about 200 acres. The Highlands form the west and northwest boundary of this plain; in other directions it is skirted by the Pacganack mountain—this range pursues a serpentine course from North Pompton to the vicinity of Morristown, separating in its route the extensive alluvial plains watered by the Pompton and Passaic. I ascended in many places and examined a considerable part of this range—the summit rock in place is uniformly a finegrained, dark secondary greenstone, often in a state of partial decomposition, exhibiting mural precipices of considerable height and extent; sandstone in place was sometimes observed at the base and sides of the mountain—I found imbedded in the summit rock (generally in decaying greenstone,) prehnite, zeolite, analcime, chalcedony, agate, amethyst, jasper, crystals of quartz, radiated and smoky quartz and narrow veins of satin spar in jasper ; the part of this range adjacent to Pompton plains may, perhaps, from the abundance of these minerals be useful to the lapidary as well as the mineralogist—the agates are from the size of a pin's head to three pounds weight, mostly chalcedony—the eyed and fortification agate I observed in a few instances. I have a mineral specimen from this mountain, found and presented to me by Judge Kinsey of Patterson, that would probably weigh eight pounds (and is but half of the imbedded mass)composed of agate, amethyst, and white quartz, in which are observed numerous deep cuniform cavities of uniform shape but differing in size—they were probably occupied by some of the decaying zeolite ; remains of laminæ, probably of stilbite, are observed in some of them. I obtained chalcedony two inches in thickness—the amethysts of Paquanack and Patterson display the characteristic coloring, are limpid but seldom observed in well defined crystals—some of the agates display a rich variety of coloring.

Another greenstone range of minor extent is situated in the great valley, the subject of examination ;—it rises near Chatham, extends ten miles, and is called Long-hill. The greenstone of this ridge is so subject to decay that rocks seldom appear in place ; prehnite was here noticed. The Passaic for several miles, near the base of the mountain, pursues a sportive course, and at times concealed in groves, then emerging, winds through extensive alluvial meadows.

About the centre of the Long-hill I observed mural precipices composed of what the farmers of New-Jersey call shell rock, resembling the stone on the banks of the Rariton.

The secondary of New-Jersey accompanies the Highlands to the Delaware. Near the village of Pluckemin and South of the Highlands, an elevated greenstone range is observed extending in a western course. Another range passes near Princeton towards the Delaware—the greenstone of this mountain that came under my observation is both coarse and fine, differing little from that of the Bergen ridge, Between the river Rariton and the Delaware, a rock differing materially from the red sandstone of the Passaic, generally underlies both mountain and valley ; after approaching the surface, it extends North to the primitive and passes a considerable distance into Pennsylvania;—it forms the nucleus of hills of considerable elevation near the Delaware, sometimes presenting mural precipices ; the red soil proceeding from the decomposition of this rock is fertile and well adapted for gypsum ; the colour of the rock is red, much darker than the Newark stone ;—this mineral appears to be without grain, to the breath it yields a strong argillaceous odour, and uniformly decomposes when long exposed to air and moisture.—I presume it is mostly composed of iron, alumine and silex with perhaps a little sulphur ; it may be called ferruginous shist—this rock is stratified, splitting readily into thin brittle laminæ, and is said to rest in some places on good freestone. Copper is the only metal sought for in this rock ; excavations are now making near Brunswick for copper, and very recently new shafts have been sunk at an old copper mine near Pluckemin—no vestiges of copper remain upon the surface at the old mine of Woodbridge.

Sandy-hill, an elevation situated between Brunswick and Princeton exhibits an alluvial composition, resembling that of the hills of Neversink; sand, white and colored clay embracing beds of ferruginous sand and pudding-stone are the minerals that compose the ridge.

The alluvial borders the greenstone ridge from Boundbrook to Springfield, to the West, in general it approaches the Rariton within two miles and forms the bed of that river a little below Brunswick. Wherever excavations have been made in the alluvial tract South of the greenstone ridge, strata of sand, gravel and clay are disclosed, but no quarries or rocks in place. Ochres of good quality are observed in many parts of this district, and at Uniontown near Springfield, compact peat of a superior quality, resting on marl and supposed to extend through a morass of five hundred acres; bones of the mastodon were discovered a few years since in this swamp. I have noticed extensive beds of pipe clay in the alluvial tract situated between Woodbridge and Amboy ; it is infusible and is principally alumine, having less than twenty per cent of silex in its composition ;—it is white and adhesive to the tongue. Petrifactions of marine shells were observed in various parts of the alluvial district adjacent to the greenstone ridge, and detached pieces of bituminous coal. The alluvial North of the Rariton above described, is connected with an extensive alluvial plain five miles in length by twenty in breadth, formed by the deposits of the navigable rivers, Hackensac and Passaic, situated between the secondary valley and the Bergen ridge ; the depth of the alluvial is from twelve to twenty feet—the basis is sand and shells like the shore of the sea—several insulated groves of lofty swamp cedars remain in the North part of the meadows. The whole tract was formerly covered with wood ; the bodies of trees but little decayed are found at various depths. An attempt is now making to reclaim a part of these meadows—it will be the work of time to produce a compact soil by the decay of the turf and other vegetable matter.—The enterprising proprietors, the Messrs. Swartouts, deserve success. A singular elevation called Snake-hill appears insulated in this verdant ocean. It is wood-clad, rocky and precipitous on the eastern, southern andw estern sides, and declines gradually to the north where it is nearly free from stone and is cultivated—the Hackensack approaches the southern and washes the western base. From this eminence the Hackensack and Passaic are seen for several miles slowly winding through the meadows and almost slumbering on the plain ; many villages, ranges of mountains, and the distant ocean are observed from this elevated ground. Greenstone, no way differing from the summit rock of the Palisadoes is exclusively the rock of this mountain, presenting in several places mural precipices of considerable height ; cubic masses of this rock are piled up at the southern base. Serpents were formerly numerous at this place ; a few rattlesnakes and copperheads remain in the southern ledges. To the North of Snake-hill an insulated tract, three miles in length and one in breadth is observed gradually rising from the meadows—no rock in place appears on the surface, but good red and gray sandstone is quarried in several places. I found micaceous iron ore abundantly diffused through the gray sandstone ; pectinites and other marine petrifactions are seen resting on the most elevated parts of the tract.

Art. II. *Account of a singular position of a Granite Rock, by the* Rev. Elias Cornelius, *(with a print.)*

Salem, Mass. April, 1820.

TO PROFESSOR SILLIMAN.

In communicating the following fact, it is not supposed that any new evidence will be furnished of a distinction which has long been made in the relative formation of different rocks. It is offered merely as another example of a *primitive limestone* ; attended with such unequivocal indications as to place its geological character beyond a doubt.

In the town of North-Salem, and state of New-York, there is a rock, which from the singularity of its position has long attracted the notice of those who live in its neighborhood, and from its vicinity to the public road, seldom escapes the observation of the passing traveller. It has not, however, it is believed, ever been described. It is situated two miles East of the academy in North-Salem, within thirty feet of the main road to Danbury in Connecticut, upon the sloping brow of a small hill or bank, whose height may be thirty feet. Although weighing many tons, its length being fifteen feet, breadth ten feet, and greatest circumference forty feet ; it stands elevated in different parts of it from two to five feet above the earth, resting its whole weight upon the apices of seven small conical pillars ; six of these with their bases either united or contiguous, spring up like an irregular group of teeth, and constitute the support of one end of the rock. The remaining pillar, much the largest of them all, stands at the lowest point of that part of the surface over which the rock is elevated, and supports its other end. Notwithstanding the form of the rock is very irregular, and its surface considerably uneven, its whole weight is so nicely adjusted upon these seven small points, one of which is six feet from the others, that no external force yet applied has been sufficient to give it even a tremulous motion.

But the singularity of its position is not the most interesting circumstance which meets the eye of the geological observer. Upon examination, he finds the rock and its pillars composed entirely of different substances. *The rock is granite; the pillars which support it are limestone.** The position also, is a natural one. There is no mountain or other elevation near it from which the rock could have been thrown. The hill in which its pillars are fixed, is penetrated with limestone rocks, with here and there a specimen of granite intermingled; so that their position has not been altered by any convulsion of nature. Here then, the Geologist finds a limestone of whose early foundation he can have no doubt. If granite be a primitive rock the strata on which it rests must at least be as early in the order of nature. From a specimen whose character is so indubitably fixed, we may proceed with safety not only to name, but to describe the species to which it belongs. Upon examination, the description of the limestone in question will not be found materially different from that which is laid down in books. Its color is white; grain, large; highly crystalline; presenting a structure, very distinctly foliated—so much so that it can easily be chipped into little rhombs which are semi-translucent. There appear to be several ranges of it in this town—in most instances they take a course northeasterly and southwesterly, with very little if any inclination to the horizon—and they generally have the same external character. The country in which they lie is very obviously a granite country, furnishing that rock in almost every variety.

Art. III. *Sketches of a tour in the counties of New-Haven and Litchfield in Connecticut, with notices of the Geology, Mineralogy and Scenery, &c. by the* Editor.—*(From the papers of the American Geological Society.)*

The following observations arose out of a journey undertaken for other purposes and occupying only five days.

The manner is more diffuse and popular than the subject might strictly demand, but this course was adopted with the hope of alluring some degree of attention to the

* Specimens both of the Granite and the Limestone which have been mentioned have been forwarded for your examination. Annexed you have a representation of the rock and its pillars as they are seen from the road and river, sketched with a pencil on the spot.

subject of geology, on the part of readers who might be repelled by a severer method.

* * * * * * *

August 26 1817.—On a very fine morning, with an excellent travelling map of the State, and with the necessary instruments, I commenced my tour in a gig.

Upon the map (which was so folded as to lie constantly open at the desired place) I wrote down with a pencil, the names of the strata at the moment of their occurrence, stopping frequently to break the rocks and to obtain specimens.

West-Rock, Secondary Greenstone Ranges, &c.

My course was nearly northwest on the great Litchfield road. From New-Haven to West-Rock, two miles, the country is alluvial, flat, sandy or gravelly.

At West-Rock, which is a fine precipice of greenstone, reposing on sandstone, we enter a beautiful and very narrow valley stretching to a great distance nearly North and South. On the right are the bold ranges of secondary greenstone, about 400 feet high, with their rude perpendicular precipices, which (except at the South end of West-Rock where they terminate, and where the cliffs have been in some measure torn down and defaced to afford building stone for New-Haven,) present a time-worn aspect;—and by the immense masses of broken rocks, which have accumulated at their feet, and slope half or two thirds of the way up their sides, evince that ages have passed since their cliffs were first exposed to the weather, and to the destroying influences of time. As we go North, the cliffs become less distinct, although probably not less elevated—but they are partially obscured by arable ground ; fields begin to slope up their sides, and cultivation appears, instead of the venerable ruins which abound farther South ; still farther North, the cliffs appear only here and there, and finally at a distance these hills assume a much more gentle outline, and appear in some measure to lose the peculiarities of aspect which characterise greenstone mountains.

The valley at their feet is fertile, abounding with green meadows ; a rivulet flows through its length and becomes the West-river, which empties into New-Haven harbour.—This valley is alluvial, although, in all probability, its foundation at no great depth is rock, and the junction of primitive and secondary country evidently takes place in this valley. It has been supposed to contain coal, and I know of no geological fact which contradicts this opinion, and there are some in favor of it.

Primitive Slate Rocks.

The hills which bound this valley on the left, are composed of magnificent ranges of slaty rock, which run parallel to the greenstone range. They rise in pretty abrupt hills of which the steepest sides are towards the greenstone : the road for some miles, runs in the valley, but eventually begins to rise sloping up the hills, and inclining a little West. Primitive argillite, or slate, highly glistening, often tortuous, abounding with veins and distinct tuberculous masses of quartz occasionally of enormous size, is the prevailing rock on the left of the valley.* It sometimes becomes almost mica-slate, occasionally alternates with that rock, and at a junction which is distinctly visible about six miles from New-Haven, the two rocks are so much blended, that it is impossible, for some feet, to distinguish them apart, although at a small distance either way they are very distinct. Good slate for building is found in these hills and carried to New-Haven.† About eight miles from that town the road suddenly turns at right angles, to the left, and we now travel, not as before, in the direction of the strata, but across them. Argillite prevails about two miles, but manifests more and more a tendency to become mica-slate—it eventually undergoes this change very distinctly, and for six or seven miles, we cross immense strata of mica-slate, having the same direction with the other slate; the strata of both are vertical or very highly inclined, and the mica-slate is frequently porphyritic, presenting distinct crystals of feldspar as large as a thumb.

* Upon these hills there are numerous masses of white quartz, of the appearance of rock salt, sometimes several yards in diameter, and quite unconnected with any rock. After seeing the slate of these hills no one can doubt that the quartz has arisen from the decomposition of the shistose strata.

† Some researches for coal have been made in these slate rocks, but, it is extremely evident that coal cannot be found in hills that are decidely primitive ; all such expectations concerning this region are baseless.

Beacon Mountain.

Fourteen miles from New-Haven, we come to Beacon-mountain, a rude ridge of almost naked rock, stretching southwest. The road, which is formed in the natural gap of the mountain, here winds through a bold gulf or defile, so narrow, that at one place only a single carriage can pass at once. On both sides the cliffs are lofty, particularly on the left; and on the right, at a little distance from the road, they overhang in a frightful manner. I climbed the hill at this place; the rocks on both sides are mica-slate with garnets and staurotide; here they had fallen in large masses, and left the projecting strata impending in a vast natural shed, under which one might be protected effectually from the weather, but with the constant apprehension of being crushed by their fall.

The ridges of the Beacon mountain present fine geological and picturesque features, and are much more abrupt and grand than most of the mica-slate regions of Connecticut.

Beyond this gap the road turns more to the left, running along a rivulet, and after three or four miles we rise some hills, and discover the Naugatuck a branch of the Housatonick passing along at the foot of other steep hills on the opposite side. It runs through a deep and narrow gulf and one looks down upon it from the high hills on which the road is laid.

Gneiss, Granite, &c.

The hills are composed of gneiss, running parallel with the ridges of mica-slate already mentioned. This is the first gneiss that occurs on the road from New-Haven at the distance of about sixteen miles.

We now pass through the little village of Salem, consisting of a few houses on the bank of the river, and whose church situated on a high hill overlooking the river, forms a striking and pleasing object.

From Salem, almost to Watertown, four miles, the rocks are gneiss—still preserving the same direction and parallelism. The county is hilly but very picturesque and beautiful.

Near Watertown, granite begins to be abundant in loose masses, and in the town I found detached pieces with garnet and sappar. Watertown, on a commanding hill, with its two steeples and its pretty white houses forms an object such as is rarely seen in travelling in England. Two miles beyond Watertown we come to ledges of granite constituting a considerable hill. Here I found much of the graphic granite and radiated or plumose mica, both very handsome in their kind. The feldspar of the granite was white with a high pearly lustre, and the grey quartz was delicately interspersed in graphic forms. The specimens were of extreme delicacy.

Mica-Slate.

As I proceeded, the granite soon changed again into mica-slate, and this continued without exception, quite to Litchfield. It often contained garnets and occasionally staurotide, and I saw loose masses of granite, with crystals of black tourmalin; while rising Litchfield-hill numerous loose blocks were to be seen of primitive limestone containing tremolite. In fact, the loose stones through the whole ride from Woodbridge hills were very numerous, but they were altogether fragments of primitive rocks—often granite, sometimes with the component parts very distinct.

Frequently the loose rocks contained crystals of feldspar as large as a thumb or finger,—so as to be quite porphyritic—they were sometimes granite and sometimes gneiss

Litchfield-Hill.

Litchfield-hill is a beautiful spot. One principal street, (intersected however by some cross-streets) extends more than a mile in length,and contains a collection of very handsome houses, with gardens and court-yards—the houses and appendages are generally painted white, and it is rare to see so considerable a number of houses in a country town where nearly all apparently belong to gentry. *In England* such a town would be a wonder, and here, connected as it is with the rich agricultural country which surrounds it,—swelled into beautiful hills, and scooped into luxuriant vallies, every where covered with lively verdure and with cultivated fields—it presents a very interesting and gratifying spectacle.

Litchfield-hill reposes on mica-slate, and this on the road to Goshen, continues to be the prevailing rock. It often abounds with garnets and staurotide—some of the crystals of the last form the cross, and are occasionally large.

Granite and Gneiss.

Nearer to Goshen than to Litchfield we cross a ledge of granite—but it is immediately succeeded by gneiss.

Goshen is a pretty village, with a neat church and a few houses in the centre, but it is principally in scattered farm-houses. In passing on from Goshen into the corner of Cornwall and to Canaan, the country becomes very hilly, and we cross great ledges of gneiss, often abounding with veins of quartz. On the road I saw two large loose masses of dolomite and quartz, with tremolite. When we are about leaving Goshen we enter a great defile in the mountain—vast ledges of gneiss are on both sides, forming entire mountains; it is in fact, a winding valley, and as far as the eye can stretch to the North, mountains rise behind mountains,

> "Hills peep o'er hills and Alps on Alps arise,"

till they die away in the distant horizon.

A valley among the mountains.

I arrived, just at night fall, at Hunt's tavern, a much frequented and very comfortable house, situated in a part of the same valley which I have already mentioned, on the banks of a rivulet, called the Hollenbeck. In this secluded spot, in the midst of mountains, I looked for an evening of complete retirement, and intended to proceed with my picturesque and geological sketch of the country.

But, I soon found myself surrounded by acquaintances, some of them old friends of my childhood; some were travelling South and some North, and this focus brought us together from remote and opposite quarters, to pass a social evening.

So far from the ocean, and in the midst of Swiss landscapes, who would have expected to hear the solemn stillness of these vallies, disturbed by naval songs! A plain man, seated in the piazza of the house, with a a voice strong and deep-toned, but clear and melodious, beguiled his evening hours, by singing the exploits of the American navy;—the verse was more remarkable for minuteness of detail, than for beauty of versification; but this performer attracted a little audience into the piazza where, in a cool but pleasant evening, (August 27) the landlord was smoking his pipe.

Manufactory of Anchors and formation of Bar-Iron.

This naval taste was easily explained by the fact, that at this place there is a considerable establishment for the manufactory of anchors. It belongs to the Hunts—(four brothers,) and has supplied many anchors for the American ships of war. Very lately, they have sent off two for the Franklin 74 gun ship—one weighed 8000 and the other 9000 pounds.

I rose very early the next morning to visit the anchor manufactory. Every thing was very obligingly explained to me, and I saw enough of the operations to obtain a distinct comprehension of them.

The iron is, *on the spot*, reduced from the ore to the malleable state. The ore is that of Salisbury—the brown iron stone of Werner. It is pulverized by a machine moved by water,—which is, in fact, nothing more than a large hammer moved by a long lever, and falling into a trough or rude kind of mortar, in which it plays up and down, and into which the ore is thrown. This receptacle is shaped like a hopper, and the pulverised ore falls through as fast as it is pounded ; it is then taken up by shovels, and thrown upon a large forge-fire, where a heap of charcoal of some bushels, is kept in vivid ignition by two bellows of great dimensions worked by water; as these rise and fall alternately, the blast is never intermitted, and the supply of ore and fuel being made, also alternately, the work goes on for many hours without interruption. No limestone or other flux is employed, and the consequence is that the operation although much more expeditious, is also much more wasteful than where the ore is first reduced in furnaces, and afterwards rendered malleable in the forge. Mr. Hunt informed me, that in this way, the ore yields not more than half its weight of malleable iron, whereas in the other mode three fourths are obtained. Indeed the dross rejected in this operation is obviously still rich in iron. I selected specimens that were brilliantly crystalized,—had the fine lustre of the Elba ores and a very considerable specific gravity. I was informed that they sometimes melt this dross over again to get more iron from it, but that in general it is neglected.

In the course of some hours, the melted ore, in a good degree freed from its oxigen, collects into a coherent, but soft mass on the hearth of the forge ; it is removed from the fire by very massy tongs, connected by an iron chain with a huge crane of wood by means of which it is swung off to the anvil, where it is subjected to the strokes of a hammer moved by water and weighing 600 pounds. The loup, as it is called is thus completed—the dross is pressed out of its cavities,—it is shaped into the form of a rude parallelopiped and indeed becomes, even by this first operation, in a good degree malleable iron.

It is now called a bloom ; it is returned to the fire and heated intensely again, and again it is hammered ; the dross may be seen exuding from its pores and dropping in a melted state—the iron becoming more and more compact and tough till it finally acquires all the properties of that most useful metal.

The iron made from the Salisbury ore is considered as remarkably tough and strong, and it is obvious that such is the belief of our government and naval men or it would not be employed for anchors for ships of war.

The blooms after they are finished, are commonly from 150 to 300 pounds weight, and from them the anchors are forged, altogether by the use of the ponderous hammers which I have mentioned. In this shop, a few years since, a four pounder was forged from malleable iron, and shewn to the Connecticut legislature at New-Haven. There was no anchor in this shop at present over 1000 pounds weight.—The price at the forge, is about eight dollars per hundred, or nine dollars delivered (at water carriage I presume.)

Manufactory of Screws.

The Messrs. Hunts have also at the same place, an establishment for manufacturing screws of the largest kinds for powerful machinery ; such screws as are sometimes many feet in length and several inches in diameter. The process by which they are manufactured is sufficiently simple, considering the importance of the result. The piece of iron being duly prepared and brought as near as may be to a cylindrical form, is placed horizontally, and connected with machinery moved by water; it is thus made to rotate rapidly, and at the same time a proper tool is so applied to it, as to cut the spiral groove, and of course to leave prominent a corresponding spiral thread.

Geological and picturesque features of the country. A waterfall.

August 28, 1817—Finding myself in the midst of a country, whose mineralogy and geology appeared very interesting, I took advantage of a bright morning, and was in my gig at a very early hour.

Lofty hills and mountains,—steep and abrupt vallies and lively water-courses surrounded me on every side. I proceeded between hills of gneiss on my way to the iron mines of Salisbury. Fragments of dolomite and other forms of white primitive limestone began to abound along the road, and many of them were full of crystals of tremolite (the grammatite of Haüy;) they afforded such beautiful specimens that I could not resist the temptation to descend very often with my hammer. It was impossible to doubt that a great change in the geological features of the country would soon be observed, and that primitive limestone must soon occur *in place.*

Accordingly, before I had gone over the four miles which brought me to the Housatonick river, ledges of white limestone began to make their appearance at some distance from the road on the right, but gneiss was the last rock which occurred before crossing the river.

The scenery was altogether wild, and possessed of very considerable grandeur. A quarter of a mile above the bridge, the river, here of considerable width, falls over a ledge of limestone (as it appeared to me at the nearest point of approach) with clouds of spray, in a white and almost unbroken sheet of water, and with the thundering noise of a cataract. I believe the fall is about thirty feet, and being all at one leap, the effect is very fine.

A Furnace.

Between the fall and the bridge, a furnace of very considerable extent was in full operation, and its clouds of black smoke formed a striking contrast with the spray and fog of the cataract. It might have been twenty-five or thirty feet in height, and ten or twelve in diameter. Vast bellows, rising and falling alternately by the action of water, threw in torrents of air, at the bottom, while at the top, the workmen were almost constantly occupied in putting in the ore, with charcoal and limestone in successive layers and in mixture. The ore is previously roasted in the open air; it is broken into pieces of a proper size, arranged in layers alternately with charcoal, and when the heap is three or four feet high the fire is kindled and allowed to burn slowly for many hours. The cohesion of the ore is in this manner impaired—sulphur, arsenic and other volatile things are expelled, and it is prepared for the fiercer heat to which it is subjected in the furnace. This last is shaped somewhat like an egg—a section being removed from each end and the smaller end being uppermost. At the top it is only four or five feet in diameter, and there is little appearance of the vehement heat which exists below. The ore, which is here melted is principally from the Salisbury bed, but partly also from the adjoining state of New-York. Both kinds are oxids, as indeed are all the iron ores which are profitably and usefully wrought; only they are more or less mixed or combined with sulphur and arsenic and with silex or flinty earth, argil or clayey earth, and other earthy matters and with foreign metals; chrome, titanium, manganese, &c. The principal steps in this operation are therefore easily explained on principle. The roasting has been already explained. In the furnace the charcoal, aided by the fierce heat, detaches the oxigen and flies away with it in the form of carbonic acid gas; the limestone although by itself infusible, by uniting with the earths and sulphur and other foreign bodies, removes them, at the same time promoting the melting of the entire mass, and thus in the language of the furnaces it acts as a flux. The iron also to a considerable extent, combines with the carbon and thus becomes very fluid, and capable of being cast into any desired form. At the bottom of the furnace, the slag or dross floating at the top of the melted iron, is occasionally raked off, and the iron is either allowed to run out at a tap-hole, or is ladled out with large iron ladles managed by hand, and thus poured into the moulds into which it is to be cast. The slag or dross which is rejected, accumulates in the vicinity of a furnace and often to a great extent; it consists of the lime which was added, as a flux, combined with the foreign earthy matters, and with a proportion of oxid of iron and other metallic oxids. It has often very gay and beautiful colours—it is inflated and twisted in various forms, or solid and firm like glass, and has in many instances, the strongest resemblance to the glasses and frits produced in volcanoes. Indeed it is impossible to contemplate the phenomena of one of these great furnaces, without finding much to gratify curiosity and much to inform the understanding. I observed the iron to be, in many instances crystalized, especially what remained in the ladles after pouring; it was in brilliant plates looking not unlike the specular ore or that variety called the micaceous iron.

Primitive Limestone in Mica-slate.

Proceeding West from the river, we cross a bed of primitive marble or limestone, and soon after we rise a somewhat arduous ridge of mica-slate, stretching North and South, and forming the boldest feature of this part of the country; it is immediately succeeded by the primitive white marble having the same direction and inclination in its strata; then again succeeds the mica-slate, and then the marble, and thus the geological traveller is gratified, in the course of five or six miles with as many alternations and successions of these two rocks, each perfectly distinct from the other, and totally different in their nature; their junctions are in some places exactly defined, and such a number of alternations and successions in so small an extent of country, and on such a scale of magnificence affords sufficient materials to occupy and to embarrass the reflections of the Geologist. These rocks are highly crystaline in their structure—they possess every mark of having been deposited from a state of chemical solution; yet what cause, existing in the primitive chaotic ocean, could have determined at one time the deposition of a rock consisting of quartz and mica, and immediately after, and without intermixture or disturbance, one consisting of crystalized carbonate of lime?

Other Furnaces.

We soon arrive at the Wanscopommuck or Furnace lake, a happy natural reservoir, of a mile or two in diameter, which supplies an unfailing stream for some of the most considerable iron furnaces in this interesting district of country. By the politeness of one of the proprietors* every facility was afforded of access to the iron establishment and to the bed of ore.

The establishment is more considerable than the one already described, and I was particularly struck with the immense piles of slag and refuse, accumulated around the furnaces.

It also struck me forcibly at both places, that the twyers (tubes) of the bellows instead of being fixed, air tight, into the side of the furnace by which means, at first view, one would suppose that the greatest quantity of air would be thrown in, and the smallest wasted, were brought only within a few inches of the furnace, and discharged their blast into an orifice of much greater surface than that of the tubes; experience, it seems, has shewn, that this is the best arrangement, and that more heat is thus excited than upon the other plan. May not the effect be accounted for, from a powerful determination of the atmosphere (created by the heat of the furnace) to enter at the same place, which as there is no grate and no admission of air from below, could not happen *provided the twyer were fixed air-tight into the furnace.* At this establishment they have cast cannon for the navy. They are cast solid and then bored out by a rotary movement produced by water. By particular management in the reduction of the iron ore, they produce at pleasure either a harder or a softer metal; the hardest is so hard that it cannot be filed, bored, or in any way altered; this is the fact with most common articles of domestic hollow ware, but that cast for cannon and some other purposes is soft and is much less brittle than the hardest kind.

Salisbury iron ore bed.

The main iron ore bed is situated two miles West of these furnaces. This of course formed an object of atten-

* John M. Holly Esq

tion. Geologically speaking, the Salisbury iron ore as is obvious from the statements already given concerning the rock formations of this district, must be considered as belonging to a country highly primitive. It may be added that mica slate, without marble, is observed between the furnaces and the ore bed; somewhat farther West upon the borders of the state of New-York, the marble again appears, but whether accompanied by mica-slate I am not informed, although it is most probable that it is.

The Salisbury iron ore may, with propriety, be referred to the mica-slate as its proper accompanying rock, because it forms the basis of the country, but the ore, as far as I could learn, is not imbedded in any rock. Its immediate bed is clay.

It is about seventy years since this great bed was opened. It lies in the side of a hill of moderate elevation, and although numerous, large and deep excavations have been made, there is no indication that the ore is in danger of being exhausted. It is not worked by shafts and galleries (as I believe iron ores generally are not) but like a quarry of stone, open to the sky, and such connexions are formed between the pits and the general surface of the country, that, to transport the ore, carts and waggons are driven freely in and out.

The ore, as already remarked, is the brown iron stone of Werner—that is, the brown oxid of iron, more or less contaminated with manganese and other metals, and with portions of earthy substances.

All the varieties of this kind of ore may be found here in great perfection and beauty, and particularly very fine specimens of what is called the brown hœmatite. Many of these, in their delicate, fibrous and radiated structure, in the highly varnished gloss of the exterior, and in the elegant stalactical forms which they have assumed, cannot be surpassed by specimens in any collections.*

Those large cavernous masses also which contain cavities usually lined with the stalactical and other beautiful forms of iron, are here abundant, and an amateur of fine specimens may here be gratified at a cheap rate.

* If I mistake not, the vertical position of the stalactites, in the ore bed, sufficiently indicates that their form is owing to gravity, while their fibrous and radiated structure, seems to depend on the laws of crystalization. On some of the Salisbury ores, there is a delicate, sooty coating which appears to be manganese, and probably affords no ground,(as some have imagined,) for inferring the agency of subterranean fire.

It has been already observed that the iron, ore at this place is imbedded in clay, so that it is obtained with comparative ease.

The clay is often stained by the oxid of iron, so that it exhibits most of the varieties of colour belonging to the ochres, and would, without doubt, in various instances, afford good painting colours. It appears in some places saponaceous, and in some instances to approximate to the properties of fuller's earth. This clay deserves further attention, and a more attentive mineralogical examination than probably it has hitherto received.

There are other ore beds and establishments in this town for manufacturing both cast and bar iron, but my time did not admit of my visiting them.

Ride to Kent.

Having now reached the proposed extent of my journey West, I turned my face South, and crossed the Housatonick some miles below the falls. In pursuing this oblique course, I necessarily crossed the strata of marble and mica slate already described.

My next object was the bed of iron ore in Kent, and in going to it my journey lay immediately down the eastern bank of the Housatonick. In driving about twenty miles, in the course of an afternoon, there was very little to detain me. My journey was no longer across the natural ridges of the country, but parallel with and between them, so that many miles presented less variety than was often seen in as many furlongs, in travelling at right angles with this direction. In a word, my whole ride to Kent was through a vast natural defile formed by two parallel chains of mountains or high hills, so near each other that there was merely room for the Housatonick to flow along, which it often did with sullen murmurs, over a very rocky and broken bed, and for a narrow road, in most instances passing directly along its banks, So abrupt were these chains of mountains, that on the western side, the river often washed their very feet, and their frowning cliffs, more or less veiled by thick forests, hung over the river. The road which I travelled, was bounded by hills almost equally abrupt, rocky and rude in their aspect, and in most instances on either side, there seemed to be no passage through these apparently impenetrable barriers.

My journey was through the borders of Canaan, Cornwall and Kent, and although, from the nature of the country, there could not be much arable land, and only a very spare population, the eye was constantly regaled with bold views of mountain and river scenery, and from the more elevated situations, the whole face of the country seemed a collection of rude hills and mountains, in most instances covered with very dense forest, the entire consumption of which would seem beyond the power of any population which is likely ever to accumulate in these regions.

The failure of a wheel, and the time consumed in securing it temporarily with cordage, caused twilight to overtake me, and the mountains closing around on every side and frowning with their dark and woody sides and ridges, seemed to cut off not only all view of any other more fortunate region, but absolutely to swallow up the road and to bar all escape.

At length, the little village of Kent made its appearance, seeming to be dropped in among the mountains, and almost secluded from the rest of the world.

The hills and mountains which occurred between Salisbury and this place, were, on the eastern side of the river, almost invariably gneiss; those on the West appeared to be the same, and without doubt they were either gneiss or mica-slate, or possibly in different places both. The hills presented the same features as those on the eastern side, and left no doubt of the general similarity of geological structure.

During the last five or six miles before reaching Kent, ranges of white primitive limestone began to attend the gneiss, and ran parallel with it, but at a lower elevation.

At the places where I had opportunity to examine, this limestone appeared in some measure mixed with the gneiss by which it is embosomed. It effervesced only partially with acids—its colour was foul and yellowish, and it was mixed with much insoluble matter probably derived from the gneiss.

August 29.—My wheel being effectually repaired by smiths whom in the evening I engaged to work with the first dawn, I set forward early for the bed of iron ore, which was at the distance of several miles. A circuitous road was said to be very good, but it would lead through the defiles, while one across the mountains was shorter but exceedingly rough, steep and difficult, and rarely travelled by any vehicles except carts.

Induced however by a wish to cross the ridges I preferred the latter road. Its difficulties were even greater than had been represented, owing I suppose to recent rains which had swept away the loose earth from the rocks and stones, and worn deep gullies.

I was however gratified to find that my previous impressions were correct, and that the ranges by the side of which I yesterday travelled, and of which these were only a continuation, were universally gneiss.

Iron ore bed of Kent.

Arrived at the iron mine the observer is forcibly struck with the magnitude of the excavation. This ore bed, like that at Salisbury, is situated in the side of the hill, but this is a high and steep one, and the ore is explored under the open sky like a quarry, with the exception of a few places where galleries of some extent have been carried into the hill. Like the ore at Salisbury, this is imbedded in clay, which in most places is the substance with which the iron is in immediate contact. Unlike the excavations at Salisbury, which are numerous but of small magnitude, this is nearly all in one great basin which in some places appeared to be 150 feet deep, and several hundred feet wide. The magnitude of the excavation has been greatly increased, by an ingenious contrivance of the present very respectable proprietor, Mr. Adam. He has turned a stream of water coming from the more elevated ground in the vicinity, through the mine, and when it is swelled by rains, it carries off prodigious quantities of clay, stones and other things, and leaves the ore which, on account of its greater gravity, remains in a great measure behind. In this manner a vast amount of labour and expence in getting rid of troublesome incumbrances, is saved. Very striking proofs of the force of the water are exhibited in the low ground beneath the mine, where great quantities of stones, gravel and earth are spread over a very considerable surface.

As regards the geological position of this ore it is a little different from that of Salisbury ; the latter, it will be remembered, is in mica-slate, whereas that of Kent is in gneiss. The section of the hill which has been made by the excavation, exposes to view a ledge of gneiss in the upper part of the mine ; it was inaccessible, but from its appearance and from the fragments which had fallen below, no doubt could be entertained that it was gneiss, especially as this rock constitutes all the neighboring country.

The clay which forms the immediate enveloping matter of the ore is very interesting. It presents a great variety of colours ; of blue, green, red, yellow, &c.—which, without doubt, arise from the oxid of iron and other metallic oxids ; good colours for painting might be selected from them.

Some parts of the clay appear very saponaceous, and the workmen assured me that a true fuller's earth, answering all the purposes of that useful mineral, had been obtained here.

A fuller's earth is a clay usually soapy in its feel—very absorbent of grease and oily matters ; fine in its texture, so as to present no parts that shall be large and harsh enough to injure cloth or wool, mechanically, by rubbing ; it should fall to powder easily in water, so as to diffuse itself through that fluid, and easily mix with it and with the stuffs to which it is applied. The fuller's earth of Hampshire, England, so much celebrated, is of a greenish yellow, tolerably firm, crumbles easily in water, receives a polish from the finger nail, and *is very powerfully detergent.* This is, after all, the important criterion by which to distinguish fuller's earth ; if it removes grease with avidity, crumbles easily in water so as to diffuse itself readily, and yet is not so coarse as to wear the fibre, it is a fuller's earth. The subject is of some practical importance to this country on account of its woollen manufactures, which, although checked for the present, must eventually rise and prevail. While they are of small extent it may be better to use soap, but in very large establishments, fuller's earth from its cheapness (provided it can be abundantly obtained) is very desirable.

With respect to the existence of fuller's earth in the clay of the Kent iron bed it appears very probable, and some of the specimens appear very like the Hampshire earth, but experiments alone can decide.

This vast bed of clay, (for it occupies more or less the whole depth of the pit) is without any reasonable doubt, interposed between ledges of gneiss, which *evidently* form its roof, and *appear* to form its pavement.

Both this ore and that at Salisbury form a striking instance of a great metallic deposit, not in veins, as most metals occur, that is, filling fissures in rocks, which fissures are perpendicular to the horizon, or form an angle and usually a considerable one with it ; on the contrary, these ores are parallel or nearly so with the horizon—that is, taking the entire deposit into view—and form, what is technically as well as familiarly, called *a bed* of ore.

With respect to the kind of ore at Kent, in a scientific arrangement it would be referred to the same species, as that at Salisbury—*the brown iron stone* of Werner or the brown hœmatite. Yet practical men assure us that the iron made from it is of a different, and as is asserted of an inferior quality, and that it is more difficult to be brought to the state of good iron.*

It would require a careful chemical examination to decide in what the difference consists (and the subject is so important as well to merit this attention,) but if judging from appearances only, we were to hazard an opinion, it would be that the Kent ore contains a larger proportion of manganese. Most of these ores of iron contain some portion of manganese, and although a small proportion of that metal does not injure iron and (as some suppose,) even benefits it ; a large proportion renders it brittle.

The impression that the Kent ore contains more manganese, is derived from the fact that the specimens have, generally, a darker colour than the Salisbury ore, and in their cavities there are appearances almost like those produced by pure oxid of manganese. The Kent ore appears to be mid way between the brown and the black iron stone of Werner ;—the latter confessedly contains a great deal of manganese, and if we are not in an error, the Kent ore bed contains more of black ironstone—the Salisbury more of the brown.

The Kent ore bed also abounds in fine specimens, the fibrous, stalactitical and mamillary varieties in particular, are uncommonly fine here, and a mineralogical traveller is strongly tempted to load his vehicle, more deeply than is convenient in so rough a country.

On comparing the specimens both from Salisbury and Kent, with those of the same species in the splendid col-

* A manufacturer of muskets assured me that he found it too brittle for gun barrels, while that of Salisbury is very tough.

lection of Col. Gibbs (most of which came from the mines in France) we can scarcely distinguish the one from the other, whether we regard their characters, their beauty, or their richness.

Ride to New-Preston.

For a series of years a highly crystaline white marble has been brought to New-Haven from the towns of Washington and New-Milford; it is in extensive use, for sepulchral monuments, as well as for purposes of architecture, although far the greater part of it is used for the former purposes.

This marble, viewed even in the hands of the stone-cutters, could leave no doubt in the mind of the geologist, that it belonged to the highly primitive formations; its perfectly crystaline structure—its high translucence—its whiteness often very pure—its freedom from any impressions of organized bodies, and its occasionally abounding with *crystals* of foreign substances, particularly tremolite, afford sufficient ground for this conclusion. I could have no doubt, according to the established laws of geology, that it must be found imbedded in gneiss or mica-slate, and most probably in the former.

I now eagerly embraced the opportunity of examining it *in place*, and for this purpose passed over east to the village of New-Preston, distant from the Kent ore bed seven or eight miles. Gneiss was still the rock which attended me; it occasionally rose into abrupt and lofty hills, sometimes composed of naked rock, with the edges of the strata projecting, and forming rude impending cliffs, threatening a fall into the vallies.

The village of New-Preston is situated on one of those high ridges of gneiss, which pass nearly North and South, and form the boldest geological features of the country.—This ridge runs nearly parallel to those which I have already described, as forming the barriers of the Housatonick as far as I pursued its course.

Gneiss, from the fissile nature of the rock, splitting readily through the layers of mica or isinglass, which forms a part of its structure, often affords an excellent building and paving stone. The Haddam stone, so much valued in New-York as a flagging stone, that of New-Milford, of Derby, &c. is of this description.

Stone houses—mode of building and of covering with cement.

Upon the top of New-Preston hill (on a spot which although rude, on account of the rocks and loose stones, with which it abounds, affords fine air and picturesque views remarkable both for extent, variety and beauty,) I had the pleasure to observe two very good houses, constructed of the gneiss rock of the country. The public house is one of them and its owner assured me that it had literally *arisen out of its own cellar*, which was wholly excavated from the gneiss rock on which the house is founded; the fragments obtained in forming the cellar had proved more than sufficient to construct the walls of the house. This house was not covered externally, with any cement, although it had been left rough with that view. It seems, the proprietor had been deterred from applying it, by the ill success of a neighbor, who having constructed a similar house, and covered it with a cement, had the mortification to see it cleave off *by the square yard at a time*. But on inspecting this house, also a very good one, the cause of failure appeared extremely obvious. The cement had been very improperly applied.

If a stone house is not to be covered with cement, it is necessary (as every one knows) to construct it with stones which have the smoothest and handsomest faces—either natural or cut by the chisel, according to the nature of the stone and the views of the proprietor, as to expence; the joints are made as nice and small as possible, and are carefully pointed, which gives this kind of building all the firmness and beauty of which it is susceptible, and it has the former in the highest, and the latter in a sufficient degree.

But, if a stone house on the contrary, is to be covered with a cement, its walls should be left on the outside *as rough as possible*—no smooth faces should be suffered to be on the outside—every such stone should have the smooth face turned inward, and no very large stones should be employed, or if they are, their faces should be as rough as possible; the stones should be thoroughly bedded *in*, and the cavities between them filled *with* mortar, *but the holes on the outside should not be stopped*—no small stones or mortar should be put in between them—in a word the whole exterior should present as many rough angular points and as many irregular, deep and *dove-tailed* cavities between the stones as possible.

The mortar should be made of the best lime, and if it is slacked with water already saturated with lime, so much the better; the sand should be very angular, sharp grained and purely siliceous, consisting of little else than fragments of quartz, (commonly called white flint,) it should be coarse, from the size of a pea to that of the head of a large pin, and mixed with the lime in about equal bulks, or as some say, six or seven parts of sand to one of lime, with the addition of a suitable quantity of hair. This mortar, in clear, and moderately warm weather, is put on with the trowel, *dashed in* with force and care into all the cavities, and floated over to the required thickness, *all at one operation*, and one day's work must be put on so soon after another that the two edges may perfectly incorporate, which will not be the fact if the former day's work is allowed to dry too much before that of the latter is put on.

Only one coat should be applied—a second would not adhere, if applied, and will come off with the frost. The work may be afterwards beautified by a lime wash made with milk instead of water, with certain additions* which the workmen pretend to keep secret, but which are very well known.

A cement put on in this manner *will stand;* and in saying this I speak from the experience of twelve years; a cement of this kind which under my observation, has been on that length of time, being as sound as the stone beneath.

In the case of the house on New-Preston hill, a thin coat was put on like a first coat of inside plastering; thus the holes which should have held the plaster firm were filled up, at the same time that the stones were scarcely covered, and when the second coat was applied, there was nothing to hold it, and of course, as might have been foreseen, it came off and left a ragged and mutilated exterior.

I speak with pleasure of seeing houses built of stone because it is high time that we should build more extensively with permanent materials, brick or stone.

* These additions are probably of no importance—the milk and the lime, appear to be all that are essential; the caseous or cheesy part of the milk forms, along with the lime a kind of varnish, although without gloss; skimmed milk will answer, *if not sour*. It is indispensable, that during the application of the wash, it be constantly stirred by an assistant, that the lime may not subside.

Stone houses properly constructed, the inside plastering not being laid upon the stone but on lath at a little distance, or, in the language of the workmen, the walls being *furred*, are much warmer in winter, and much cooler in summer, are in a great measure indestructible by fire, and by time, need little repair* and *are never damp ;* on the contrary, if furred, *they are perfectly dry.*

If plastered upon the inside, directly upon the stone, they will be damp, not however from moisture passing through the walls, which is never the case in a well built house, but from condensation of the vapour of the atmosphere, the thick masses of stone not suddenly changing their temperature, and stone being a pretty good conductor of heat, when the atmosphere becomes charged with vapour and warm withal, the vapour appears on the wall in drops, as it does on a tankard or other vessel filled with cold water, and suddenly brought into a warm and moist air.

From this digression, which will perhaps be pardoned from the practical importance of the subject, we return to our geological investigation.

Beds of primitive white Marble.

The ridge of gneiss, on which New-Preston stands, stretches away South and somewhat West to New-Milford. Descending its eastern declivity I turned abruptly to the right, and followed the direction of the ridge of gneiss, travelling parallel to it. The beds of marble soon made their appearance in a valley through which runs the little river, the eastern Aspetuck, issuing from the Raumaug lake, in the northern part of Washington, and emptying into the Housatonick at New-Milford. Along this little stream, and at small distances from it, are situated the principal marble quarries, and they are opened and wrought at short intervals through an extent of seven or eight miles, almost to the main street of New-Milford. The marble, as it lies in its native beds, has a very beautiful appearance, being, as already observed, very white and looking almost like beds of snow. Some of it is large grained, composed of plates of perceptible

* It is indispensable, that in houses covered with cement, the water should no where get into or beneath the cément, for, it will then cause it to cleave off with the frost. There is no danger of this, if the cornices and other similar parts are well secured.

magnitude ; in other places it is fine grained, looking almost like lump or loaf sugar. Some of it is decidedly what mineralogists term dolomite, and all of it comes under the denomination of granularly foliated. It is, according to scientific arrangements, of the same kind with the statuary marble, and yet, it may be questioned whether any of it would answer for statues. Those of the ancients were made principally from the Parian marble, so called from its coming from the island of Paros in the Grecian Archipelago, although it is well ascertained that several other islands, as Naxos, Tenos, &c. in that sea afford similar marble : I believe all the statues of the moderns and some of those of the ancients are composed of the Carrara marble, thus denominated from the place where it is found in Italy. To fit a marble for the use of the statuary, it should be highly crystaline, and yet with a pretty fine grain ; it should be perfectly white, entirely free from flaws and from foreign minerals, and it should be very firm. The finest pieces of Washington and New-Milford marble probably come as near this description as any marble as yet found in this country, but it is too often mixed with tremolite, often indeed in such fine crystals and other forms* that it is very beautiful to the eye of a mineralogist, although it would be a blemish to the statuary.

The most beautiful pieces of this marble are apt to be of the most tender consistence, and an artist after toiling with immense pains to finish a fine statue, would be very much chagrined to find a delicate prominent part, as a nose, an ear, or a lip, suddenly break off, or filled with crystals of tremolite.

Statuary marble, although not a remarkably hard stone is one of the most durable. Hence, says Patrin, "it is sought for, for the construction of the most sumptuous edifices, and of monuments which are intended to be at once magnificent and durable. Marble is one of the least destructible materials ; of this we have proof in those precious statues which are an eternal monument of the genius of the artists of ancient Greece. They have supported the injuries of twenty centuries while the scythe of time has not been able to glance on the brilliant polish of their surfaces."

These ranges of marble extend a great way North and South, and are quarried in many and distant places. In the

* Scarcely inferior in beauty to the tremolite of the Alps.

present case the sawing is performed by the waters of the Eastern Aspetuck ; the quarrying is carried on in the usual manner. One circumstance however was novel to me.—The marble is easily divided by wedges in the direction of its stratification, but if they wish to produce a vertical crack, they can effect it, and at the same time produce a horizontal one in the following manner. An auger is provided which is exactly of the form of an equilateral triangle ;—with this, a triangular* hole is bored, in such a manner that the basis of the triangle is in the plane of the horizon, or of the stratification, and of course a line let fall from the vertex so as equally to bisect the base, would be perpendicular to the horizon, or to the stratification. When this hole is charged with gun powder and fired in the usual manner, two cracks are produced, one horizontal or in the direction of the stratification, and on both sides of the hole, and the other perpendicular to the first.

I was gratified to find the geological associations of this marble very distinct and exactly such as I had been led to anticipate.

This marble forms a perfectly distinct bed in gneiss, which is found on both sides of it, and of course both above and below it. As we travel on toward the centre of New-Milford, the gneiss makes its appearance in various places in the road, and is every where attended by the marble.—According to the systematic arrangement of Mr. Werner, this is therefore the oldest primitive limestone, forming distinct beds in gneiss. I was very solicitous to observe the junctions of the marble and gneiss, and was gratified in various places. The transition from the one rock to the other was, however, in general, not perfectly abrupt, and a sensible intermixture of the two rocks could be perceived for some feet on both sides of the junction.

The two rocks accompany each other quite into the main street of New-Milford, and cross the river Housatonick some little way below, and without doubt proceed on to Danbury, Reading, &c, where primitive limestone is found.

The geological relations of this marble appear then to be perfectly distinct.—I may say they are very grand in their extent, and give us new reason to admire, that wonderful order and harmony, little suspected by people in general,

* It would not *necessarily* be triangular—if the auger should be suffered to revolve, in the usual manner, the hole would of course be circular.

which are found equally in the mineral kingdom, as in the animal and vegetable, and which afforded, on analogical grounds, the best reason to predict, that the geological association of this marble would be found to be what it actually is.

New-Milford.

I had some hours at New-Milford before night, and they were busily occupied in packing my specimens, and in viewing the town and its vicinity.

The public burying ground strikes a traveller forcibly, on account of the great number and crowded state of its monuments, and their being, almost without exception, constructed of the snow-white marble, so abundant in the vicinity.

New-Milford has had the reputation of not being a healthy town. Bills of mortality, averaged for a good number of years, afford the only adequate means of deciding a question often agitated between different towns. New-Milford has of late years, had some sickly seasons, and so have most towns in Connecticut, however healthy they may be reputed. It is true we must not infer from this that there is no difference in the health of different places. It is however probable, that in New-Milford, the great show of monuments, (many of them very beautiful in their design and execution) arises from the facility, with which the material is obtained in the neighborhood.

New-Milford lies in a valley on the banks of the Housatonick ; high hills cut off the view to the East, and indeed in almost every direction, and this low situation, with the effects of evaporation from stagnant water, have, in popular opinion, given rise to its reputed unhealthiness.

This town is situated principally upon one main street, with some windings and branches. In few towns in Connecticut, is there so great an inequality in the appearance of the houses. Some are more than commonly mean and ruinous, while a considerable number are beautiful, and some even splendid. One house, built of brick, is very expensively ornamented with the white marble, which, beside many other costly decorations, forms a superb arch over the door.

Our country is still too recent to afford the traveller many of those biographical, and other interesting historical notices which are so common in Europe. It could not, however, be uninteresting to know, that this town was the early residence of the venerable senator, Roger Sherman: his house, a plain old building, is still pointed out, and his name will be remembered as long as talent, integrity, and patriotism shall command the respect of Americans.

August 30th.—With the rising sun I left New-Milford, and bending my course East, passed a succession of rough and arduous ridges, to the Shepaug river. In the distance of five or six miles, the succession was gneiss—gneiss—gneiss—mica-slate—gneiss—gneiss,—which last terminates in an alluvial tract upon the banks of the Shepaug, a river which empties into the Housatonick. The rocks of mica-slate, abounded with garnets, and had time permitted, many fine specimens might have been obtained.

Mine Hill—Quarry of Gneiss—Spathic Iron.

At the Shepaug, I quitted my wheels, and, with a guide, proceeded, on horseback, two miles North, to the silver mine, as it has been called, siutated in a forest, upon the last ridge of gneiss which I had crossed. The hill, from its steepness and roughness, and the thick forest by which it is almost every where covered, is difficult to ascend.*

This hill is called Mine-hill, from its having been explored some years ago by mining operations. The excavations were made at several places, but chiefly at one, where we soon arrived. I have been assured by a son of the person who carried on the work, that without any doubt, silver was obtained there in some quantity, but not enough to render it profitable, and the work after being carried on to a very considerable extent, a deep shaft having been excavated, and great quantities of different minerals thrown up, was abandoned.

Of the silver, I could at present, discover no traces but, from some specimens, from this place, which I saw some years since, I am led to suspect that the ore was the sulphuret or the vitreous silver ore of Werner.

Every thing here, however, indicates a metallic vein, and the relics of the mine still remaining in great abundance, give sufficient indications as to the principal contents of the vein.

* As a guide is indispensable to those who visit this interesting spot, it may not be amiss to mention for the benefit of future mineralogical travellers, that any information will be obligingly imparted, at the house of a respectable man, (Mr. Trowbridge,) who lives at the foot of the hill.

There were several metallic sulphurets, quartz in abundance, and often crystalized, and, more than all, and what had principally drawn me to the place, *spathic iron.* This remarkable mineral, which, in small quantities and much mixed with other minerals, is a very common companion of metals in their veins, is however, rarely found in great quantities in one place. France, and especially Germany, is remarkable for mines of spathic iron, and although we have some few American localities of it mentioned in professor Cleveland's mineralogy, there is, so far as I am informed, no evidence that in this country it exists any where, in quantity, except at this mine.

Tons of it lie here upon the ground, and no one in this vicinity appears to know what it is, nor does it appear ever to have entered into the views of the proprietor to turn it to account.

It is very well characterized. Its structure is distinctly foliated, with a triple cleavage, producing rhombic fragments, the surfaces a little bent : the colours are from yellowish white, deepening through various shades of yellow and brown, to almost black ; the surfaces which have been acted on by the air, are the most deeply coloured and their interior, when a piece is broken, is much whiter : the specific gravity is four, water being one.

It is entirely indifferent to the magnet till it has been heated red hot on charcoal, when it becomes very sensible and flies to the magnet almost with the avidity of iron filings. It does not often appear crystalized, but when it is, the crystals are very flat, that is to say, very obtuse rhombs. Quartz is its immediate gangue, and many specimens are found, in which it is beautifully interlaced with this mineral, and occasionally a fragment presents a ground of dark coloured spathic iron, with white crystals of quartz, perforating it in many places, and directons and thus presenting a kind of mosaic.

In the above description, it is presumed every mineralogist will recognize the spathic iron. This kind of iron ore is entirely different from that of Salisbury and Kent. It is essentially composed of oxid of iron, united to carbonic acid, and usually to lime ; it contains also variable proportions of manganese and sometimes magnesia. It appears to be essentially a carbonate of iron, but it is rare that lime is not also present.

Hence probably it is, that, ordinarily, in reducing it, it is not necessary to put limestone into the furnace, as in case of other iron ores; the lime, or in other words, the flux, is present in the ore itself, and little or none need be added.

But this is not its greatest excellence—

It affords steel directly from the bar without the process of cementation. Hence, in Europe this ore is much valued, as the iron bar drawn out by the trip-hammer in the common process of blooming, is iron or steel at pleasure, according as the process is managed; this is not true of any other ore, and hence probably this has been called the steel ore. The steel made from it is not of the finest kind, it is used principally for agricultural and other coarser instruments.

The gneiss rock in which this spathic iron lies, is within the limits of the town of New-Milford, and on account of the important use which is there made of this rock, it is worthy of a moment's attention.

It is, as already remarked, *gneiss*, but singularly perfect in its characters, and it is questionable whether for purposes of architecture the world can produce its superior.

Both its stratification and its schistose structure are so perfectly regular and continuous on one right line, that slabs of it of any length which can be lifted, can be raised from the quarry so regular in all their dimensions, and so even in all their surfaces, that they are hardly, excelled by hewn stone. The colour also is of a light, agreeable grey; the finest houses in New-Milford have this stone for their door-steps and basement; and its natural surfaces, or those, which, at the ends and edges are but slightily modified by the hammer and chisel, are so perfect that nothing finer need be wished for the construction of the handsomest houses in cities. Could it be easily transported to New-York, this stone would be a more valuable possession to the proprietor, than the mine of silver or iron.

I was informed that one stone was actually removed from the quarry, of the astonishing length of forty feet, with such a breadth and thickness, as corresponded to the purpose for which it was to be used. It is worth the trouble of a visit to New Milford, if it were for nothing else than to see this incomparable kind of building stone. In its native bed, it has the general stratification of the neighboring country, both with respect to the direction and dip of the strata.

Rattle Snakes—anecdote of one.

I was informed by my guide that rattle snakes had formerly been very numerous upon this hill, and were still found there in considerable numbers. He accorded with the general impression as to their torpidity, and the slowness of their motions, but stated the following fact, as of his own knowledge. One of his neighbors, a young man, meeting with a large and vigorous snake, of this species, instead of despatching him at once with his long cart-whip, which he could easily have done without the slightest danger, (as it is well known that they are killed very easily) amused himself by provoking him, by gently playing his whip around his body. The irritated reptile made repeated and vigorous leaps towards the young man, coming nearer to him at every effort, and being teazed more and more by the whip, at last threw himself into the air with such energy, that when he descended, he seemed scarcely to touch the ground,—but instantly rebounding, executed a succession of leaps, so rapid, and so great, that there was not the slightest intermission, and he appeared to fly. The young man betook himself to a rapid flight, but his dreadful pursuer gained rapidly upon him, till approaching a fence he perceived that he could not pass it before the fangs of the snake would be hooked in his flesh ; as his only resource, he turned, and by a fortunate throw of his lash, by which he wound it completely around the serpent's body, he arrested his progress, and killed him.

Few animals are furnished with more dreadful means of destruction. I had a living one nearly two months in my possession, and every day watched his manners. Birds, and most small animals, when put into his cage, he immediately killed, but did not eat them ; a toad he permitted to remain with him for weeks unmolested, and even seemed attached to him, as he would permit him to leap upon his body, and even to sit upon his head. He took nothing except water, which he drank in large quantities, but rejected every thing else, although tempted with very many things ; he grew emaciated, and at the approach of cold weather died. But he was six weeks in full vigour. When he opened his mouth his fangs were not visible, unless he was provoked ;

at other times they were covered by a membrane like a scabbard, only they were drawn back, so that the sheathing membrane formed only a slight protuberance on each side of the upper jaw. If irritated, he flattened his head, threw it back, opened his mouth wide, and instantly the fatal fangs were shot out of their sheaths, like a spring dagger, and he darted on his object.

After his death I examined the fangs; they were shaped like a sickle—a duct led from the reservoir of poison at the bottom of the tooth, quite through its whole length and terminated just by the point, which was exceedingly sharp. Thus the fang is darted out at the will of the animal—it makes the puncture at the instant, and, simultaneously, the poison flows through the duct and is deposited in the very bottom of the wound. As this rarely fails to touch a blood vessel, the venom is thus instantly infused into the system, and without delay commences the march of death through every vein and artery.

These facts, I am sensible, are not new, but they are not often related by eye witnesses, and nothing regarding the history of this tremendous animal can fail to be interesting.—How happy is it, that the poison of the rattle-snake, is not conjoined with the size of the Boa-constrictor, and with the speed of the antelope!

Ride to Woodbury.

From the Mine-hill, through Roxbury, to the vicinity of Woodbury, eight or nine miles, the country was an uninterrupted succession of high hills, and deep vallies—not mountainous, but forming vast curves, and causing the face of the ground to swell and sink so regularly, that the traveller is almost constantly either ascending or descending. The hills were composed of gneiss, not naked as I have heretofore described, but covered with soil and cultivation, and following the general direction and stratification of the country. Near Woodbury the rocks presented some tourmalins.

On reaching the top of a high hill, all of a sudden in a valley stretching North and South for a mile or two, Woodbury appears, with a handsome, well built street, and furnished with three churches, with spires,—two of them new and handsome. For one of these churches, it seems the town is indebted to a dissension as to the location of a house of worship, which, as usual in such cases, ended in the building of two new ones.

Woodbury basin of secondary Greenstone, &c.

While descending the last hill, the geological traveller is forcibly struck with the new physiognomy of the valley in which Woodbury lies. Its features are totally different from those of the country on which he still is, and from those of the remoter regions all around.

Abrupt fronts of dark coloured naked rock rise perpendicularly from flat, and apparently, alluvial plains.—They have mural precipices and sharp ragged ridges, fringed with wood, and are marked by a great accumulation of ruins of the rock, sloping from the foot half or two thirds of the way up the rock; on the opposite side of the hills the descent is gradual, without precipices, and comparatively easy.

No one who with habits of observation has travelled from New-Haven to Hartford, and so on to Northampton, and Deerfield,—no one, in short, who has ever been conversant with a trap country, can fail almost at first glance to refer this to that class of rocks. It is the whin stone of the Scotch—the grunstein or greenstone of the Germans, and, in a popular way, may be referred to the same family of rocks as the Giant's Causeway and the cave of Fingal.

As the traveller descends into the valley, all his impressions are fully confirmed by discovering red sandstone in the structure of the houses and by finding a quarry of it worked at the foot of one of the ridges of rock. In a word, this is a basin of secondary greenstone, or trap, reposing on the old red sandstone of Werner. After being so long occupied in the regions of gneiss and other highly primitive rocks it is gratifying to find thus suddenly so new a feature in the geology of the country.

On consulting Mr. Machue's late geological map of the United States, I find that this spot did not escape his sagacity; he travelled over it, and has laid it down as secondary, and belonging to the old red sandstone formation.

From our being now within twenty-four miles of New-Haven, it might be imagined that this tract is merely a branch of the great secondary trap formation which commences at that town ; but it will appear that it is not ; on the contrary, it is perfectly distinct—it is strictly a basin ; an island, (if I may say so,) of secondary trap, in the midst of an ocean of gneiss.

We find accordingly, a total change in the minerals of the country. Very beautiful prehnite is found here abundantly, lying loose among the stones at the bottom of the precipices ; it is in mamillary and botryoidal masses, or in almost perfect spheres, and sometimes in veins, and the structure is in diverging fibres,—the colour a delicate green. I have seen it no where so fine or so abundant in this country. Agates are also found here, and zeolites and some of them handsome. In other parts of the same tract, bituminous stones are found. I have a piece of fibrous limestone, from this tract, which is so bituminous that it looks as if soaked in tar and will burn with flame.

My time did not permit me to coast around this basin, and ascertain its extent and its relations with the precision which I could have wished. It evidently reached but a mile or two North of where I then was, and, returning to New-Haven, I rode through its length in that direction, and should place its entire length at seven or eight miles. Its breadth extended but a little way to the East of the North and south road which I was travelling, and judging from the contour of the hills to the West, I should imagine that it was succeeded by gneiss at the distance of two or three miles from the road.

I know of nothing in this country similar to this basin, except the coal basin of Richmond, which, although small, is much larger than this.

A friend,* to whom in a letter I described this basin, remarks upon it :—" The county of Antrim, in the North of Ireland, presents numerous patches or districts of trap and basalt, in such relative positions as to render it very evident that after a surface consisting partly of bare primitive, and partly of hard chalk with flints had been formed, this was

* The Rev. Henry Steinhauer, Principal of the Moravian Institution of Bethlem, Member of the Geological Society of London, and formerly a missionary among the Esquimaux of Labrador.

April 19, 1819.—Science, humanity, religion and friendship have now to deplore the death of this excellent and able man, from whom, as Principal of the celebrated Moravian Seminary at Bethlem, in Penn. and as an ardent cultivator of the natural science, this country had much to hope.

completely covered with a stratum of trap, which by some subsequent operation, was carved, united to its subjacent masses, into the present surface of the country, so as to be detached in some places, and to remain contiguous in others. Is there any reason (independent of the theory of universal formations, which I think must not be taken quite for granted, particularly in the late or upper formations) for supposing that the trap of your neighbourhood, once was continuous over a much larger extent of country?"

My present impression is that the trap of Connecticut and Massachusetts, has not extended over more country than it now occupies. But this subject may at a future time be resumed.

In Southbury, numerous low, conical hills, of sand and gravel appeared, and formed the basis of the road.

Recurrence of primitive country,—and ride to New-Haven.

The gneiss again came in, in the southern part of Southbury, and northern part of Oxford, and its ledges continued for two or three miles east and South of Humphreysville, where they form the bed and banks of the Naugatuck river, and contribute to diversify the scenery of that romantic spot.

The rocks which intervene between this place and New-Haven, are the same ranges which, a few miles North, I passed in the commencement of this tour. They are, for two or three miles mica slate—then chlorite slate, much mixed with epidote and with spots of calcareous spar, and containing also beds of trap, which from its position must be primitive. At one place on the top of the high hill, from which we descend into New-Haven—the trap, perfectly distinct at the distance of a few feet from the chlorite slate, forms a visible junction with it, and graduates into it so insensibly, that it is impossible to mark the line of distinction. Indeed, in its passage, it puts on very distinctly the appearance of greenstone slate. Upon these ranges of chlorite slate and clay slate, which succeed, lie vast isolated masses of trap, without any apparent connexion with other rocks; they seem to be of the same texture with the secondary greenstone or trap, and perhaps give some countenance to Mr. Steinhauer's suggestion.

Descending the hill, trap and argillite and chlorite slate, several times alternate, and form the cliffs through which the road has been wrought.

Scenery.

Now a combination of fine objects, breaks upon the view. On the left the magnificent ridges of secondary trap, (mentioned in the commencement of the tour,) stretching away North, farther than the eye can distinguish, and forming the barrier of luxuriant vallies, whose fine verdure is admirably contrasted with their naked and lofty precipices; further East, other and still other ranges succeed, till their faint outline is blended with the distant sky; immediately at our feet, is the great alluvial plain, from which rise the smoke and the spires of New-Haven, and further still its extensive bay, surrounded by alluvial and secondary, but terminated at its mouth, by primitive country, closing in upon both sides; and much more remote, but distinguishable in the distant horizon, appear the shores and coast of Long-Island, with the intervening sea and the craft and ships which it bears on its bosom.

General Remarks and Conclusions.

In Dr. Bruce's Journal, Vol. 1. pa. 139, I have given some account of the secondary greenstone formation, on which New-Haven stands. It is obvious, from the preceding statements, that immediately on leaving this plain, the rocks in the order in which they are described above, become primitive, and it is worthy of observation that, taking into view an extent of thirty miles, the structure of the country presents, almost precisely the arrangement and succession of rock formations, which are laid down by Mr. Werner.

1. Clay slate, including beds of trap, and passing occasionally into chlorite slate.*

* Within a mile south of the road, on which my returning tour crossed these slaty rocks, commence beds of serpentine marble, which continue eight or ten miles to the sea, and become the beautiful material, so nearly resembling *Verde Antique*, now largely quarried and wrought. This extraordinary bed of marble and serpentine, is well worthy of a more particular account.

2. Mica slate succeeds and occupies the country, for many miles.

3. Gneiss succeeds to the mica slate, and occupies the country for many miles more.

4. Granite crowns the whole, although it occupies but a small extent* compared with the gneiss and slaty rocks.

5. The relative elevation, is on the whole in this order, and we find clay slate occupying the lowest and granite or gneiss the highest situation.

6. Near Watertown where the granite was observed, the next formation, is mica slate, which occupies about fifteen miles in breadth to Goshen, where granite again appears.

7. The north western corner of the State, where we have now arrived, presents immense ranges of gneiss and mica slate, with a new and very interesting feature.

8. This feature is the existence of vast beds of white crystalized primitive marble, and, including the formation further south, between New-Preston and New-Milford—these beds of marble, are included in strata of mica slate and gneiss—the whitest and most crystaline and purest marble being in the gneiss.

9. West of Litchfield, a few miles, (as I am informed from the best authority,) there are hills of primitive hornblende and sienite.

10. A little West of New-Haven, as described in Bruce's Journal, (Vol. I. pa. 139,) are beds of primitive trap.

Thus it appears that in the district described in the tour are included very nearly all the important primitive rocks of Werner, and the secondary district, on which New-Haven stands, includes a considerable portion of his secondary formations.

The direction of the ranges of primitive rocks, is generally North, a little inclining to East, and of course South, a little inclining to West; the inclination of the strata, is to the East, at an angle, varying very much in different places; the strata are in some places, nearly vertical and in others, at angles of less than 45° with the horizon.

* Possibly it is only in veins.

Art. IV.—Localities of Minerals.

Localities—communicated by Professor Dewey *of Williams* College.*

The new locality of serpentine, was found in Middlefield, Hampshire County, by one of our graduates, E. Emmons of that town. It is connected with the beds of soapstone; indeed, the soapstone often passes into serpentine. It occurs, *green* of various shades, *reddish brown*, *gray*, *yellowish-white*, and *cream-coloured*, with spots of a *smoky* hue, like *smoky* quartz in this respect, but certainly serpentine. It is sometimes associated with quartz, filling the cavities of strata of quartz, covered with minute crystals. Its hardness is very variable—some of it is disintegrating, some is fibrous, and seems to be passing into asbestus. Much of this serpentine, especially the lighter coloured, is remarkably fine. The whitish decrepitates much, when high temperature is suddenly thrown upon it. Odour is strongly magnesian, when the mineral is breathed on. In some specimens are *yellowish* and *reddish brown* portions of a crystaline structure, and in some, cavities are filled with these imperfect crystals. They break into a rhomboidal form, and are sometimes very regular rhomboids. Some of them, are so closely serpentine, that they may be all the same mineral. They contain, like the rest of the serpentine, magnesia, oxyd of iron, often so minute, that they are discoverable only under a magnifier, or by the magnet.

Mr. Emmons has also found, beautiful masses of *actynolite*, often containing small tufts of the *fibrous variety*. White *talc* is often mixed with the actynolite.

Bitter Spar, is found there also, in the soapstone, associated with beautiful *green talc*. The spar is laminated, white, and yellowish—but some specimens, when fractured, presented numerous small rhombs.

I have found in Sheffield, (Mass.) masses of Tremolite, with fibres two feet long. I never heard of such tremolite.

* In Prof. Dewey's piece, (Vol. I. pa. 337,) Williams College is erroneously printed Williams' College.

Hexagonal crystals of mica.—They are in granite. As I did not notice them at first, I cannot tell where the granite was obtained, but believe it was from Chester or Westfield, on the granite ridge. Some of the crystals are small, not more than one tenth of an inch on a side and almost regular hexagons. Others are larger, and have unequal sides.—The real size of them is here given.

No. 1. *No.* 2. *No.* 3.

The sides are generally very perfect, and some of the crystals much resemble those you mentioned in the Journal from Porto Rico. It is probable that other specimens of hexagonal crystals may be obtained on the granitic ridge in this State. An attempt to measure the angles of No. 1, gave angle a=122°, b=126°, c=112°, d=121°, e=108°, and n=132°. The sum is 721°, and should be but 720°. The above angles may therefore be taken as very near the truth.

In No. 3, the angles were as follows, a=116°, b=124°, c=129°, d=112°, e=122½°, and n=117°, being only 720½°, and approximating nearly to the truth. I do not suppose the angles are very accurate, for I had no good means of measuring them. In some of the crystals, the sides are more unequal than in No. 3.

In some rhombic spar, containing the new mineral, Brucite, from Sparta, N. J. I found several *hexagonal* crystals of mica.

Crystals of Tremolite, in dolomite, from Great Barrington. These crystals are much compressed, and the diedral summits rather rounded, so that they become *bladed* crystals. They are from one half inch to two inches, or more, in length, and some of them three fourths of an inch in breadth. They are found in hard rocks of dolomite, above ground, and very abundantly, in the very friable dolomite, under the surface of the earth. The *fibrous* and *acicular* varieties of tremolite are abundant in the South part of this county.

Brown Spar from Leicester, N. Y. on Genesee river.—The crystals are rounded, or *lenticular*, and often so grouped, as to have a scaly appearance—colour, dark brown, with a resinous lustre,—translucent,—becomes yellowish before the blowpipe. The crystals appear to connect prismatic masses of limestone, or of limestone mixed with some alumine. The whole dissolves perfectly, with effervescence, in nitric acid.

Iron Sand.—From the shore of Lake Erie, near the river Ashtabula.—It is found in considerable qnantity.

Pisolite.—From Chicopee river, Springfield, Mass.—These are globular concretions, from a very minute size to 3-8ths or 1-2 inch in diameter, often connected together in large quantities.—Ash-white on the outside; inside, dark grey; pretty hard, opaque, concretive layers often scarcely discernible.—I have never found any nucleus of any extraneous mineral.—Effervesces considerably in nitric acid. Composed of very minute particles of carbonate of lime, silex, and alumine; the last appears to predominate.—Hence when breathed upon, they have an argillaceous smell.—I believe they are called *clay-stones* commonly, but I know not what mineral to refer them to, except *pisolite.*—They have somewhat the appearance of small concreted stalagmites; but their location and composition do not well agree with this mineral. This notice may lead to examination of them.

Localities by Mr. Amos Eaton—*from the minutes of the Troy Lyceum.*

White Augite—Sappar—Plumbago—Adularia.—In the granular limestone of Canaan, Washington, and Brookfield, in Connecticut, tremolite abounds, and in Brookfield, the white variety of augite is abundant.

Near the northeast corner of Haddam, on the East side of the river, in the parish of Middle-Haddam, is a new locality of sappar. It is on the farm of a Mr. Selden, from whom I received specimens, with fibres, from six to eight inches in length. It is here found in mica-slate, as at Chesterfield and Conway.

Above six miles in a southeast direction from Brimfield, and two miles East of Holland meeting-house, is an extensive bed of Plumbago. Several years ago, this mine was wrought, and many tons of plumbago were taken from it.—The beds of plumbago, lie between layers of gneiss, in connexion with hornblende, perfectly pure, except that it contains cobalt ore, like the hornblende of Monson and Chatham.

In Brimfield, in Massachusetts, the stone wall, near the house of Dr. Lincoln, and of the widow of Gen. Eaton, abounds in adularia. The feldspar part of a large portion of the granite and gneiss of that vicinity, is supplied by the most beautiful adularia. The sulphuret of molybdena, also is there very common—it is found chiefly, in veins of granite which traverse gneiss.

* * * * * *

Localities of Minerals, observed principally in Haddam, in Connecticut, in Sept.* 1819, *by* Dr. J. W. Webster. *Communicated in various letters to the Editor.*

I have discovered a new locality for tourmalin of great beauty, and of remarkable regularity of form; it is about one mile beyond the rock which Col. Gibbs blasted, some years since, for small, short Tourmalin, which rock, is in the road, four miles from the inn, at Haddam. The strata in this place, are, mica-slate and gneiss, frequently alternating, and passing into each other, traversed by veins of granite of various size;—following the beds of these rocks, through a thick wood, I observed the tourmalin increase in quantity, and size, towards the more elevated part of the beds of mica-slate, a blast being made, the rock appeared wholly composed of a yellowish granular quartz, and black tourmalin, which were thrown out in profusion, being easily separated from the granular quartz. Every crystal was perfect, having three lateral planes, and being terminated at each extremity with three; the terminal planes set upon the lateral. The diameter varies from 1-6 to 1-2 an inch, but I afterwards observed some with a diameter of two inches, less perfect however.

In another letter, it is remarked, I have found a new locality of black tourmalins, all doubly acuminated, and none less than an inch and a half in length, by one in diameter.

* Haddam is about twenty miles from the mouth of Connecticut river, on its western bank, and about 100 miles N. E. from New-York.

About three miles West of the tavern in Haddam, in a cross road, Dr. Webster says, "I discovered in a vein four inches wide and four feet long, in a decomposed mica slate, and in the sand proceding from its decomposition, the finest crystalized epidote, which I have seen from an American locality; the specimens are, many of them, precisely like those from the Oisans. We have here, in short, the pistacite, zoizite, and epidote arenacè.

[Mineralogists, are generally aware that the only known locality, of crysoberyl *in place*, is in Haddam. It is in a very beautiful granite, consisting principally of a white feldspar and a grey quartz, the parts very large, and it abounds with garnets, some of them of a great size, with tourmalins and fine fibrous white talc. This rock is in the court-yard of a dwelling house, and passes under the house, into its cellar. Mineralogists have found it necessary, and *just*, to insure the proprictor of the house, against their gunpowder blasts, and to pay him liberally for the molestation of his peace.]—*Ed.* Of this rock, Dr. Webster observes:

The rock containing chrysoberyl, is undoubtedly a vein, traversing gneiss, we believe. I obtained permission to blast, and dig round for some yards. The part which had been hitherto concealed by earth, is most abundant in garnet, and I obtained masses two feet in length, with *perfect* garnets, four, five and six inches in diameter, but all laminated. In one specimen, consisting chiefly of mica, are very perfect black tourmalins. In the mica slate of this vicinity, I found considerable actynolite.

At about three miles beyond Jewitt's city, on the left of the road to Norwich, is a magnificent example of a concentric globular concretion of gneiss, many yards in diameter, the only instance I know of in this part of the United States. At Bozra, I found tourmalins, and fine graphic granite;—at Tolland, remarkably transparent garnets, of a nearly rose red colour—also, good epidote of an olive green;—At Tolland, graphite disseminated through rolled masses of granite and gneiss;—at Sturbridge, adularia*;—at Charlton, radiated tourmalin.

* Mr. T. D. Porter, has shewn us specimens of adularia from Haddam.[*Ed.*]

New locality of crystalized sulphat of Barytes, &c.—Communicated in a letter by D. B. Douglass, *assistant professor in the West Point Military Academy.*

During my excursion to the northwest, last summer, as astronomer to the Boundary Commissioner, I was enabled to make a considerable collection of minerals;—among the rest, a rich one of Niagara specimens; also some very fair specimens of organic remains from fort Erie—upon the islands at the West end of Lake Erie, I obtained sulphat of barytes, which is found both in crystals, and in mass, in great abundance, in the western islands above mentioned. The crystals are very flat hexagonal prisms, clustered together rather confusedly, and adhering very slightly to each other; they are generally very clear and pellucid, sometimes tinged with blue.

Localities of Minerals.—Communicated by Dr. I. F. Dana.

Tremolite, (bladed,) abundant, and of a fine quality at Chester, N. H.

Plumbago, in small rolled masses, and in small veins, in micaceous schistus, at Chester, N. H. Some specimens are very fine, and in laminæ, as large as the hand and half an inch thick.

Epidote.—Epidote, very beautiful, in radiating crystals, in Exeter, N. H.

Localities of Minerals.—By the Rev. Mr. Schaeffer of New-York.

Pistazite, (Epidote,) in beautiful crystals, occurred in a rock of singular constitution, composed of schorl, quartz, cubic, [cuboidal? as the cube is not among the forms of carbonate of lime,—*Ed.*] crystals of carbonate of lime, indicolite, &c. and an *ore*, the nature of which is not yet ascertained. It is probable, however, that it may contain *nickel*. Corlaer's Hook, New-York, discovered nearly three years ago.

Pistazite (epidote,) amorphous, or rather granular,—occurs in a ferruginous green feldspar rock; Rhinebeck, Dutchess County. N. Y.—observed last summer.

ART. V. *On some ancient human bones &c. with a notice of the bones of the Mastodon or Mammoth, and of various shells found in Ohio and the west;* by CALEB ATWATER, Esq.

Circleville, May 22, 1820.

TO PROFESSOR SILLIMAN.

Dear Sir,

IT has been said, that neither the bones of man, nor the remains of any of his works, have been found in any of the rock formations of our Globe. This may be true of all parts of the earth except Ohio. In this region however a number of skeletons have been found in two places at least, and the works of man have been discovered in many others. To what epoch or catastrophe of our globe, they are to be referred, I leave others to decide, while I proceed to relate the facts.

I am credibly informed, that in digging a well at Cincinnati in this state, an arrow head was found more than ninety feet below the surface. The geology of that place has been well described by Dr. Drake, in his "Picture of Cincinnati." It is a very ancient alluvion. Nine miles South of the present shore of lake Erie, at Ridgeville, Cayahoga county, several feet below the surface, in the ridge, which was once the southern shore of the lake, several bricks, and one or more human skeletons were found, which from every appearance were deposited there by no human hand.* They might have been thrown on the shore, with the cedars which surround these remains, before the lake receded to its present bed. Similar indications have been observed in Huron county immediately West of Ridgeville.† We may account for those found in Huron, in the same manner as those discovered at Ridgeville.

At Pickaway plains, about three miles South of this town, while several persons were digging a well, several years since, a human skeleton was found‡ seventeen feet six inches

* Fact derived from Moses Eldred, Esq.

† Authority, Israel Harrington, Esq. of Lower Sandusky.

‡ By Major John E. Morgan.

below the surface. This skeleton was seen by several persons; and among others, by Dr. Daniel Turney, an eminent surgeon of this place; they all concurred in the belief, that it belonged to a human being. Pickaway plains are, or rather were a large prairie, before the land was improved by its present inhabitants. This tract is alluvial to a great depth; greater, probably, than the earth has ever been perforated, certainly than it has been here by the hand of man. The surface of the plain is at least one hundred feet above the highest freshet of the Scioto river, near which it lies. On the surface is a black vegetable mould, from three, to six, and nine feet in depth—then we find pebbles and shells imbedded among them: the pebbles are evidently rounded and smoothed by attrition in water, exactly such as we now see at the bottom of rivers, ponds and lakes. I have examined the spot where this skeleton was found, and am persuaded that it was not deposited there by the hand of man, for there are no marks of any grave; or of any of the works of man, but the earth and pebbles appear to lie in the very position in which they were deposited by the water. This skeleton is no more, but one skull found nearer still to this town, a drawing of which accompanies this communication, I have been careful to preserve for a similar plate. (See 2d plate.)

On the North side of a small stream, called Hargus creek, which at this place empties into tne Scioto, in digging through a hill composed of such pebbles as I have described in Pickaway plains, at least nine feet below the surface, several human skeletons were found, perfect in every limb. The drawing* which I have annexed, is exactly one fourth part as large as one of these skulls which is in my possession. These skeletons, thus found, were promiscuously scattered about, and parts of skeletons were sometimes found at different depths below the surface. This hill is at least 50 feet above the highest freshets in the Scioto, and is a very ancient alluvion, where every stratum of sand, of clay, and pebbles, has been deposited by the waters of some stream. Near this hill is a large prairie, several miles in length, and nearly half a mile in width, which, from every appearance, has been the bed of the Scioto,

* Although I profess no skill in drawing, I believe the draft is correct.

when it was probably a mighty stream, compared with which, it is now a mere brook. There are other skulls in this town taken out of the same hill, by the persons who, in order to make a road through it, were engaged in taking it away.

These bones are very similar to those found in our mounds, and probably belonged to the same race of men. These people were short and thick, not exceeding generally five feet in height, and very possibly they were not more than four feet six inches. These skeletons, when first exposed to the atmosphere, are quite perfect, but afterwards moulder and fall into pieces. Whether they were overwhelmed by the deluge of Noah, or by some other, I know not, but one thing appears certain, namely,—that water has deposited them here, together with the hill in which, for so many ages they have reposed. Indeed, this whole country appears to have been once, and for a considerable period, covered with water, which has made it ONE VAST CEMETERY OF THE BEINGS OF FORMER AGES.

* * * * * *

Terebratula pennata, &c. &c.

Sept. 24th, 1819.—I send you four drawings of articles found by myself, (see plate I.) No. 1, represents what is to me an incognitum; I do not find the like in Parkinson's "Organic Remains," nor in Sowerby's "Mineral Conchology." The drawing represents it exactly. It is a carbonate of lime. You see but two sides, or the half of it, yet from them you may get a good idea of the whole. No. 2, 3, is a petrified shell, classed by Sowerby under the genus Terebratula, although this species is a nondescript. I would propose for it the name of "terebratula pennata," as the projections on its sides may well represent wings. I would thus describe it—rectangular, middle of the front, greatly depressed; the depression striated crosswise; the striæ extending to the beak; ten deep indentations on each side of the depression; the lower valve greatly elevated, corresponding with the upper valve. The margin deeply and angularly serrated, with teeth corresponding with those in the other valve. A straight line from the hinge to the extremities of the wings. Beaks rather curved, with an indentation, forming a semicircle in the centre of the beaks. This beautiful specimen is a light drab-coloured limestone. Fig. 3, shews the hinge of "terebratula pennata."

No. 4, is a very beautiful specimen, and belongs to a new species at least, if not a new genus. It was found by my little daughter. It is not injured as most other specimens are, as its shell is almost perfect. The drawing shews its size.

Fig. 5, a detached vertebra of an encrinite, though larger, than described by Parkinson. This is composed of limestone, and the surface is beautifully and distinctly articulated. I have many specimens of the encrinite; some quite perfect.

* * * * * *

Notice respecting the teeth and bones of the Mammoth or Mastodon.

Oct. 11, 1819.—The teeth of the mastodon in my possession, resemble those of carniverous animals more than any with which I am acquainted. Those found in this state, vary in size, and are always found in alluvial earth, or in the beds of creeks. One of mine, were it not broken off, would weigh nine or ten pounds; the weight of the other is given, as well as its size. The latter, was found by a child, at play in a small rivulet, near the Pickaway plains; the former was found in the bed of salt creek, twenty-two feet nine inches below the surface, by Judge Givens, of Jackson county, Ohio, while engaged in digging for salt water. Two or more ribs, several joints of the backbone, &c. were found with it. Near this place several teeth of the mammoth belonging to different individuals, have been found at different times, some of them lying on the surface of the earth, and a few relics below it; the former, I should rather suspect, were brought here, principally by the Indians, the latter lay in the place where the animals died. A large thigh bone was lately found near this town in digging a mill-race. Several teeth of the mastodon have been found along the Scioto river, on the southern beach of Lake Erie, and at Dayton on the Great Miami. Several bones belonging to this animal have been discovered near Cincinnati, and some in a good state of preservation in the counties of Athens and Meigs.

References.

[Print at the end.]

No. 1, 2, B. two views of a mastodon's tooth, found in the bed of a small river near Pickaway plains, Ohio. Weight, 5 lbs. 6 1-2 inches from A. to r.—from 1. to 1. three inches.

No. 1, 2, A. two views of a tooth found in alluvial earth, twenty-two feet nine inches, below the surface, in digging a salt well at the Scioto salt-works. These teeth are in the cabinet of Caleb Atwater, Circleville, Ohio. The latter tooth weighs nine pounds, though several fragments have been broken off. Its original weight was probably from 12 to 14 lbs. at least.

ART. VI. *Geological section from Taconick range, in Williamstown, to the city of Troy, on the Hudson, by Professor* DEWEY.

Williamstown, July 4th, 1820.

TO PROFESSOR SILLIMAN.

Dear Sir,

I INFORMED you sometime ago, that I intended to continue the Geological Section from the Taconick range, in this town, to the city of Troy, on the Hudson. I have before noticed the rocks on the roads from this place to Troy, North and South of the direct line, and I have lately passed on this line from Troy, through Brunswick, Grafton, and Petersburgh, over the Taconick range, to this town.—Through these three towns to Troy, the distance from the West line of Massachusetts, is very nearly twenty miles in a straight line; and as the rocks are similar on the routes North and South of it, the geology will embrace a section several miles in width. It will be recollected, that the rocks of the Taconick range in this town, were stated to be argillaceous-slate, chlorite-slate, and talcose-slate. The last predominates, and abounds on the descent of the range into the valley of Petersburgh. This valley, of variable breadth, extends several miles North and South, and is traversed by a stream which runs northward, into Hoosack River. In this valley is found abundantly the same mixture of chlorite and quartz, which is so common in Williamstown, though the two vallies are separated by the Taconick range, having an elevation from 1000 to 1400 feet. As this range is broken through by the Hoosack, a few miles North, and as the same mixture may be traced, and often found abundantly along the Hoosack, to the stream which runs through Petersburgh, the chlorite and quartz, undoubtedly follow up this stream, through the valley. On the West side of this valley, and about seventeen miles East of Troy, lies

Chlorite Slate, very distinctly characterized. It is sometimes narrow, and sometimes two or three miles in width, often rising into hills 200 or 300 feet high. As this rock is found on the Taconick range, and forms a part of it, especially a few miles North of this place, it ought perhaps to be considered as belonging to the range, and as the rock into which the talcose slate actually passes. Its strata extend into the next rock, or

Graywacke. This rock begins to appear about sixteen miles East of Troy, covering the surface in rounded masses, of very various size, and forming also vast strata, rising into hills in Petersburgh, constituting the mountains of Grafton, and extending as the general rock through Brunswick, to Troy. The mountains of it in Grafton are, as I judge, from 800 to 1200 feet in height. It is, like all the other strata from Hoosack mountain to the Hudson, inclined to the East, at various angles, from 10° to 40°. Its general inclination may be 20° a 25°. It consists of quartz, cemented by a greenish argillaceous substance, which generally forms the principal part of the rock, and is evidently a mechanical deposit. The quartz is sometimes very fine, but generally is readily seen by the eye, and is occasionally so large and abundant, that it resembles breccia. The fracture often shews the quartz to have been rounded masses, and in these cases the stone does not appear porphyritic. In other cases the stone is so very compact and close-grained, containing also feldspar, that it might have passed for porphyry, had it not been connected with specimens which could not be mistaken. This rock, though quite tough in the cross fracture, readily breaks into *prismatic* fragments, along its veins, which are usually filled with quartz. By the action of the weather, large rocks are divided into innumerable prismatic bodies. A small stream, which rises in the mountains in the East part of Grafton, and runs westward into the Hudson, below Troy, affords an excellent opportunity for examining the position of this rock in numerous places. Occasionally there appear in this rock, beds, or veins, of a reddish argillaceous slate, in Grafton and Brunswick.

Near Troy, the graywacke has a much finer texture, and darker colour, and some of it takes a fine polish.* Where the graywacke stops near Troy, there begins a bed or stratum of

Argillaceous Slate.—It extends to the bank of the Hudson, and has a similar inclination to the East. It must doubtless be considered as the next rock in order, or as forming an extensive bed in the graywacke. It is full of natural seams, which divide it into small plates, and easily disintegrates. A large quantity, thrown into a street in Troy, has by the action of the weather, and constant travelling upon it, become in one year, complete clay. Both the graywacke and argillite are evidently *transition* rocks.* The slate is very different from that which occurs in Williamstown, and along this part of the Taconick range, and which seems to me clearly *primitive*. It will doubtless be found by future observation, that the roof-slate of Hoosack, N. Y. which appears to be a continuation of the Taconick range, is separated from the argillaceous transition slate, which extends for many miles along the Hudson, below and above Troy, by the same stratum of graywacke. I noticed no graywacke-slate on this section, but it is found very perfect in Chatham, a few miles southeast of Albany. Specimens of the above rocks will soon be forwarded to the Geological society.

Should you think the above worthy of publication, I should be glad to see it because this section will be pretty complete from twenty miles East of Connecticut river to the Hudson.

* * * * * *

* See Eaton's Geology.

Wavellite?

I have lately analysed a mineral, found by Mr. Emmons, in an iron mine in Richmond, in this county. It is *new*, or a new variety of *Wavellite.*

Colour, greenish white ; scratches crystalized carbonate of lime, but is less hard than fluate of lime; infusible by the blowpipe ; and sp. gr. about 2. 4. It occurs in a stalactical form, or as an incrustation, presenting many small mamillary concretions, which, as well as the stalactites, are composed of minute radiating crystals, or crystaline fibres. Its lustre is rather weak—rather tough to break, but is pulverised without difficulty in a glass mortar. It contains a little less than seventy per. cent. of alumine, much water, and a little lime and silex. From an examination of several specimens, the lime appears to be variable. The above characters bring it so near *wavellite,* that I am inclined to think it only a *variety.*

When pulverised, it is nearly all dissolved in solution of pure potash by heat. If nitric acid be poured on the solution, very nearly the whole is dissolved as a nitrate. The remainder is clearly silex. If the nitrate be mixed with carbonate of potash, and the precipitate be well washed, it is nearly all dissolved by pure potash. The remainder is lime—is perfectly dissolved by nitric acid, or forms a milky mixture with sulphuric acid, and the sulphate of lime is soon precipitated. When the alkaline solution is precipitated by an acid, and the precipitate well washed, and sulphuric acid added, you have the full and distinct taste of alum. There can be no doubt of the general constituents. Several days after I had obtained these results, a letter from Dr. Torrey, of New-York, informed me that he had obtained the same results,* except the lime. I can, however, no more doubt about the lime, than about the alumine. Probably the lime is accidental, and his specimen contained none.

* A letter from Dr. Torrey, to the Editor, dated Sept. 22d, confirms this statement, and promises a detailed analysis, which we should be glad to see, especially as it appears that the analysis of the Wavellite has been recently repeated in Sweden, by Berzelius, with the following result ; Alumine, 35, 35 ; phosphoric acid, 33, 40 ; fluoric acid, 2, 06 ; lime 0, 50 ; oxids of iron and manganese, 1, 25 ; water, 26, 80.

Art. VII. *Remarks on the environs of Carthage Bridge, near the mouth of the Genesee River; by* Dr. John I. Bigsby, *of the medical Staff of the British army in Canada.*

TO PROFESSOR SILLIMAN.

Sir,

I have the honor of addressing to you a few observations, on the environs of the justly celebrated bridge at Carthage, on the Genesee river, in the State of New-York.

The Genesee river falls into lake Ontario, on its South coast, about ninety miles from Fort Niagara. At its mouth, on the left sloping grassy bank, stands the village of Charlottestown, a small, and irregular cluster, of dwellings, stores and taverns. The river is here perhaps two hundred yards broad, but it varies much during its course. The banks soon rise to the height of from 80, to 140 feet, and continue to ascend to the first falls, five miles from the lake, where they are 196 feet high. They are always steep and covered with trees, especially cedar and hemlock, growing among ferruginous brown sandstone in debris, and shivered horizontal layers.

The Steam-boat Ontario, from Lewistown, stops at "Hanford's Landing," a mile below the first falls; where two storage houses and a small wharf stand on a narrow slip of ground, under the high and woody steeps.—A winding road leads up the precipice.

On the summit of this road we are surprised to find ourselves at once, in a populous district, among cultivated grounds, and handsome stores and houses, distributed according to the interest of the proprietors.

Advancing a mile, along the river, on the road to Rochester, through fields and woods, we arrive in view of Carthage bridge. It is first seen from a small elevation, to cross among lofty and dense foliage, a gulf 200 feet deep, and 340 wide, whose mural sides are curiously striped by white and red strata. At the near end, a tasteful lodge is erected for the accommodation of the toll-gatherer.

It consists of a single arch, 342 feet in width, a segment of a circle, I believe. The whole edifice is of wood, and is 740 feet long. Its breadth allows of neatly railed paths, on each side, for foot passengers, and of ample space in the middle for carriages to pass each other. The approach at either extremity being a gentle descent, a slight concavity is therefore given to the road over it, to preserve its evenness and continuity. It cost 16,000 dollars, and to the honor of the American name, is the work of the artizans of the neighbourhood.* The toll is very unproductive ; but the lands in its vicinity have risen considerably in value.

I need scarcely observe, that from the water, at the distance of three hundred yards, it forms a grand and singular spectacle. The gloom of the narrowed and sunken river, gives a glow and brightness to the objects above, and especially to this graceful and Iris-like fabric, which is seen white, and high in the air, striding the precipice, and partially concealed in pines, oak and beeches. Looking onward, under the arch, the view is speedily terminated by a very picturesque cascade seventy feet high : the quantity of water is not great, but is most advantageously displayed, by dashing on two successive ledges, from which, arching beautifully, it loses itself in the wreathing spray, that ever plays around the foot of the bare red rock. It is surrounded in the back ground by finely disposed foliage of various kinds.

On crossing the bridge, (still proceeding to Rochester,) we find a straggling assemblage of houses, called Carthage, all evidently of the most recent date, and of ordinary appearance, except two exquisite specimens of domestic architecture. They are superbly furnished, and seem rather to be denizens of the most refined cities, than of this wilderness. The town is principally occupied by husbandmen. and contains the common proportion of well frequented taverns, but no church. The land is undulating, and full of stumps, and blackened decaying trees.

Passing to the right, on the high banks of the Genesee. and through mingled cleared grounds and woods, for three hundred yards or more, we meet with another fall of ninety feet in height, and apparently more plentifully supplied with water ; which passes in an unbroken, and almost transparent curtain, over a gracefully curving line of rocks. It is also embellished with trees and small heights. A mill is erect-

* It was erected from scaffolding, on the bed of the river, which here contains very little water.

ing to take advantage of a part of its water ;—as has been done at the five minor falls which pour over the adjacent West bank, at some distance from each other. They are the outlets of channels which the level of the country, now low and swampy, has permitted to form.

The town of Rochester is half a mile higher up the river, a good road, through the woods and fields leading to it. In June, 1819, this settlement was four years old, and then contained about three hundred houses in compact, regular streets. The inns are excellent; and the stores frequently with their gables to the street, are shewy and well stocked. The town possesses a printing office and newspaper. The streets are scarce cleared of the tree-stumps ; but they are lively and busy : commerce and manufactures are carried on with the facilities and steadiness of a Hanse town, whose organization possesses the experience of a thousand years.

Almost all the town is on the West side of the river, but many good houses are on the other, and communicate by a common wooden bridge of three abutments. Looking upwards from this bridge, you have rapids passing noisily over two ledges of rock which at the distance of fifty and a hundred yards cross the widened river. The left shore is a sloping meadow : the right is low, and intersected by numerous streamlets, each of which has its petty cascade, and its mill for oil, wood, and flour. Woods are close at hand in the rear.

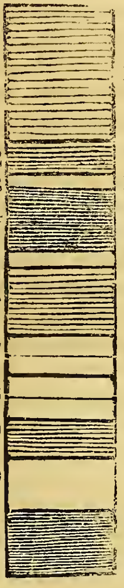
The view downwards is something similar. The West side is more covered with houses and opulent establishments, which, indeed, *stretch* a mile or more.

The stratification of the banks of the Genesee river, can be best observed about Carthage bridge. Here they are perpendicular, and dilate so as to give the horse-shoe form to the chasm included between the bridge and first fall—narrowing at the same time under the former. Large masses of debris occupy the foot of these walls. The West side of the precipice above the bridge is imperfect ; a narrow grassy ledge having formed at midheight, succeeded by a steep slope, which is loaded with trees. The higher portions *in general*, are often much comminuted and very earthy.

The rocks on both sides of the river, at this point, and at different parts of the same side, correspond in kind and situation.

The upper strata are limestone, and are here inaccessible, but can be better investigated at the second falls. A brown, compact conchoidal lime is the first; the next is brown, rather crystaline, and full of shells of a pearly lustre; a third is bluish and contains fewer shells. Broader layers succeed, having black flint nodules imbedded.

The order of the whole succession of strata is as follows:



1 Layers of Limestone.

2 Limestone and bluish Shale alternating in this stratum.

3 Ferruginous Sandstone.

4 Greyish blue Shale, as at the falls of Niagara—very dusky.

5 A white Clay—giving not the minutest effervescence in acids.

6 Dark red Sandstone; highly ferruginous—in many parts having globules of black metallic lustre.

7 As No. 10, but of lighter colour.

8 As No. 10.

9 Do. but stratified thus

10 Bright red ferruginous Sandstone, with yellow spots, and circlets on the fracture surfaces. It is a compact mass.—Nos. 7, and 8, have each one line of division.

11 Shale alternately grey and red.

The surface of some of the sandstones, as No. 10, is impressed with the figure of confused bunches of twigs or branches, having transverse ribs at regular distances, like the bamboo cane. No. 6, contains a few pebbles, and many elongated univalve shells. Among the debris of this chasm, a ferruginous puddingstone of quartz pebbles occurs, but I could not find it in position.

The banks of this river are highest at Carthage bridge. From their gradual subsidence towards the lake; and from their higher parts being covered with soil, little limestone is seen below; while above the first fall, (excepting the lowest stratum,) no other is met with—but the successive bluffs which it forms are so shivered and moulded that their stratification, colours, &c. are very indistinct. At the second fall, and near Rochester, this rock is less disintegrated.

JOHN I. BIGSBY, M. D.

Quebec, April, 1820. *Assistant Staff Surgeon.*

BOTANY.

Art. VIII. *Floral Calendar, for the years* 1815, 16, 17, 18, *and* 19 *; kept at Deerfield, Mass. North Lat.* 42° 28′, *West Long.* 72° 39′.—*One hundred miles from the sea coast.—By.* Dr. Dennis Cooley.

In this calendar, a few of the most common plants are selected, because the change in these at the time of flowering is most striking, and because they are most widely disseminated through the country ; and are, therefore the best species for corresponding observations. The first column marks the first change in the foliation of a forest of oaks, chesnut, maple, and birch, perceptible at the distance of half a mile. This change, it is well known, is generally very rapid and distinguishable ; and therefore, it was thought proper to be noticed.

Forest rapidly changes.	Apple-tree in full flower.	Common red garden Cherry in full flower.	Years.
May 15	May 28		1815
8	27	May 11	1816
8	24	13	1817
24	30	22	1818
7	24	22	1819

Red Currant in full flower.	Martins first appeared.	Barn Swallows first appeared.	Harvest of English grain commenced.
May 11	April 22	April 24	August 8
10	26	May 1	July 28
23	23	April 17	20
20	24	26	28

Remark.—Such concise results of extended observations, are desirable, but it may not always be convenient to insert very voluminous details of daily floral occurrences.—[*Ed.*]

Art. IX. *May not the state of those indigenous plants, which blossom late in the season, indicate a late or an early autumn? by Professor* Dewey.

The flowering of plants early or late in the spring, and the maturity of fruits early or late in the summer, are ever considered proof of an early or late season. The following facts give some plausibility to the opinion that the state of the later plants may be some index also to the season of autumn. They are the result of observations for the last four years. The plants which invariably flower comparatively late in the season, at this place, are several species of aster, and solidago, and gentiana, and hamamelis virginica. In all these plants, except hamamelis, whose fruit is ripened the succeeding spring and summer, the process of maturing their seed seems to proceed rapidly, and the cooler temperature of Autumn to be favorable to this process. The summers of 1816 and 1817 were considerably colder than those of 1818 and 1819. The *mean* temperature of the three summer months was as follows—for 1816, 63° 46; 1817, 64° 41; 1818, 68° 57; 1819, 68° 84. The season of 1816 will long be remembered for its cold. In this year, however, hamamelis and some species of solidago, which were all I then noticed, blossomed earlier than in either of the last two years. And in 1817, several species of the above genera flowered from *ten* to *fourteen* days earlier than in the two following years. But in 1816 and 1817 the autumn was much earlier, or vegetation was stopped by the cold much earlier than in 1818 and 1819. In 1816 the first severe frost was August 29th, and after September 20th severe frosts were frequent. In 1817 the first severe frost was October 1st, and they occurred often after the middle of the month. In 1818, except on September 27th, there were no frosts of consequence till November. The first hard frost was October 6th, in 1819; and again towards the end of the month. The above mentioned plants are uninjured by frosts which will kill our exotics. They cannot, however, endure repeated and severe frosts. So much later did these plants blossom in 1818, than in 1817, that it seemed impossible for their seed to be matured, unless the severe frosts should be later than in 1817, and I was thence led to remark to several persons the probability that the autumn would be later. For the same reason I made the same remark last autumn. In both cases the remark was verified by fact. The promise of God, "that seed-time and harvest shall not cease," and the ordinance, "let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind," while they are not inconsistent with the failure of harvest and fruit in a particular place, or with the extinction of some species of vegetables, seem to authorize the general expectation that the fruits will be matured, and that when the time of flowering is later, the season will be adapted to the state of the plants. As we have earlier and later autumns, it is at least worthy of observation, whether the time of flowering of the later plants does not correspond to them. Botany might, perhaps, be then applied to another practical advantage. The plants would be very easily known from their being late in flowering.

If it be true that the cooler part of the season is more favorable to the vegetation of the above plants, as the difference in the time of their flowering seems to indicate, there is an obvious reason why their flowering should take place earlier in a cooler, than in a warmer summer. A similar reason will doubtless account in part for the well known fact, that if the flowers of the annual plants be cut off, new shoots set for flowers, and actually blossom also in much less time. The difference in the temperature, from that naturally adapted to them, appears to change their course of growth and to bring their seed in less time to maturity; so that the plants appear to adapt themselves to their situation, and the season, in order to perfect their seed.

The preceding facts may seem to throw some uncertainty upon the results of observations made for the purpose of ascertaining the climate of different places from the time of the flowering of plants. In places not very remote, however, the results would not be affected in a given year. Observations for one year, would not evidently be sufficient, if the places were distant. A series of observations for as many years as would be required to effect the same object by the thermometer would be necessary. In addition to this there must be more uncertainty in the results, if the places be not remote, when the smaller and annual plants are selected for observation, rather than the larger plants, and especially trees. That such observations may be relied upon, the *same plants* should be observed, and the circumstances of *place*, *soil*, *aspect*, *exposure to winds*, *&c.* should be similar. All these affect the plant, and alter the time of flowering.—I have known the common dandelion in blossom here on the 18th of March, though it does not usually flower till about five or six weeks later. Claytonia spatulata flowers some weeks earlier on a southern aspect, and where it is also protected from winds, than on a northern aspect, only a few rods from the former. The same is true of epigaea repens. Tussilago farfara blossoms some days earlier on the wild bank of a brook, than in the warm and rich soil of a garden. Chrysosplenium oppositifolium, shews its flowers ten days sooner in still waters, than beside brooks, where it is much less exposed to the sun. Also viola rotundifolia. The above circumstances are so liable to be different in different places, that the results cannot be very satisfactory when the smaller and annual plants are observed. There is another circumstance also, which increases this uncertainty, if the places be considerably remote. There may be several days in the beginning of April, for instance, warmer at one place than at another. As this would there bring forward the earliest plants sooner, a warmer climate would be indicated. But, should a few cooler days succeed, as is usually the case, vegetation might be no earlier on the whole after a fortnight, than in those years in which the same plants first showed their blossoms several days later. I have occasionally found a plant in blossom here, about a month preceding the time given by Muhlenberg for its flowering in Pennsylvania. These facts prove, not that the flowering of plants does not indicate difference of climate, but that much accuracy of observation, for a series of years, is necessary, if those plants be selected for observation, which are easily affected by changes of temperature, aspect, &c. in order to ascertain the climate or comparative mean temperature of different places.

In respect to *trees*, the case is somewhat different. They are not so readily affected by changes of temperature. But the above mentioned circumstances of situation are seen every year to have considerable influence upon their time of flowering. The result of observations on trees will, however, be most entitled to confidence. Dr. Bigelow, in his paper on this subject, an abstract of which was given in the 1st No. of this Journal, selected the *Peach-tree*, from the numerous plants whose time of flowering had been observed. This was a very judicious selection. It seems desirable to prosecute the subject, and that several trees should be observed at each place, and at the *same stage* of flowering. The last particular appears very important. For from the conclusion of Dr. Bigelow, it will be seen, that a difference of about *four days*, corresponds to a difference of *one degree* of latitude. Observers may be expected to differ at least two days in the time that a tree may be thought to be *fully* in bloom.

I have made these obvious remarks, because they present some of the difficulties in obtaining very definite and conclusive results upon climate from the flowering of plants, unless there be very accurate and continued observations; and, I have made them in this place, because they were connected with the immediate object. Whether these difficulties be considered as great as they appear to me, the conclusion to be drawn from the observations upon the last four years in relation to a late or an early autumn, will not be essentially affected.

Williams College, April, 1820.

FOR THE AMERICAN JOURNAL OF SCIENCE.

ART. X. *On the manufacture of Sugar from the River Maple, (Acer eriocarpum, of Linnæus;) by* DR. JOHN LOCKE.

IT seems not to be generally known, that sugar is afforded in any considerable quantity, by any other species than the sugar maple, (*Acer saccharinum*;) but I have found that in some parts of New-England, more sugar is made from the river, than from the sugar maple.

The facts I have ascertained, with regard to the making of sugar from the river maple, I collected in Fryeburg, (Me.) on the Saco river, where large quantities are annually made; but before I state them, I will give some account of the two species, the sugar and river maple.

The family of maples is distinguished from other plants, by the fruit, which consists of two peculiar seed-vessels, united at their base, each dilated into a membranous wing above, which serves to suspend it awhile in the air as it falls.

1. The Sugar Maple, *(Acer saccharinum, Linn.)* called also rock maple, has leaves five-parted, and yellowish green flowers on flower-stalks. It is one of the largest and loftiest trees in our forests. Its trunk is usually straight and entire to the height of from 40 to 80 feet, where it suddenly unfolds into a dense top, crowded with rich foliage. The bark of the older trees is of a grey colour, and marked with numerous deep clefts. The wood is firm and heavy, though not durable. It is used for various work by carpenters and cabinet makers. Micheaux says, that it grows in its greatest perfection, between the 43d and 46th degrees of North latitude, and of course, in the northern part of our States, and in Canada.

The River Maple *(Acer eriocarpum* of Linnæus,) called also White maple,* and by Eaton Silver maple, is distinguished by having its leaves five-parted, and white beneath; its flowers reddish yellow, without flower-stalks, and with woolly germe. The trunk frequently divides near the ground, so as to appear like several trunks close together. These divisions diverge a little as they rise, and often at the height of from eight to twenty feet the top commences. It is generally larger in proportion to the trunk, than the top of any other tree. The bark has its clefts more distant than in the sugar maple, and is more inclined to scale off. It blossoms earlier than the sugar maple. The fruit is larger than that of other species, it advances with great rapidity towards perfection, ripens and falls in June, and produces a plantule the same season, sufficiently hardy to withstand the succeeding winter. The fruit of the sugar maple does not ripen until October. The river maple is principally found on the banks of rivers, and on the banks of such only as have a clean gravelly bottom, and clear water. It is most luxuriant, on such flats as are subject to annual inundations. and is usually the first settler on such flats as are making in-

* Micheaux says, that in the Atlantic States, this species is confounded with the common red maple, but in the Western States, it is generally distinguished and known by the name of White Maple.

to the bends of streams by alluvial deposits, the opposite bank being at the same time worn away. " The banks of the Sandy river, in Maine" says Micheaux, " and those of the Connecticut in Windsor, (Vt.) are the most northerly points at which I have seen the white maple. It is found more or less on all the rivers in the United States, flowing from the mountains to the Atlantic, but becomes scarce in South-Carolina and Georgia. In no part of the United States is it more multiplied than in the western country, and no where is its vegetation more luxuriant than on the banks of the Ohio, and of the great rivers that empty into it. There, sometimes alone, and sometimes mingled with the willow, which is found all along these waters, it contributes singularly by its magnificent foliage to the embellishment of the scene. The brilliant white of the leaves beneath, forms a striking contrast with the bright green above, and the alternate reflection of these two surfaces in the water, heightens the beauty of this wonderful moving mirror, and aids in forming an enchanting picture, which during my long excursions in a canoe, in these regions of solitude and silence, I contemplated with unwearied admiration." I have seen it in Maine, on the banks and islands of the Androscoggin, on the Sunday river, a tributary of the Androscoggin, with remarkable crystaline water, and on the Saco where it is abundant, and attains a large size, especially in and about Fryeburg, where I found several trees measuring between fifteen and eighteen feet in circumference. I have seen it in various places on the Connecticut, particularly at Hanover and Windsor, and also on the Ashuelot in Keene. In several of these places, particularly on the Saco and Androscoggin, it grows in great luxuriance, and occupies considerable tracts, nearly to the exclusion of all other trees. I never contemplated a picture in landscape with more delight, than I have the banks of some of these streams, when viewed from the opposite shore. The tops of the trees present one continued range of foliage, which rises like a fleecy cloud, changing beautifully in the wind, as the upper green or the under white surface is presented to view. This cloud of leaves, is supported by the clusters of trunks, like so many gothic pillars, forming a variety of deep shaded arches and avenues beneath. I mention its beauty, because I think it deserves attention as an ornamental tree. In a poem written in Fryeburg called "The Village," the following lines are bestowed upon it.

" More sacred than the thunder chosen oak,
" Let not the maple feel the woodman's stroke.
" Fair maple ! honours purer far are thine
" Than Venus's myrtle yields, or Bacchus's vine ;
" Minerva's olive, consecrated tree,
" Deserves not half the homage due to thee.
" The queen of trees, thou proudly tower'st on high,
" Yet wave thy limbs in graceful pliancy."

* * * * * *

The wood of this tree is light and soft. The sap-wood is very white and has been used by cabinet makers to inlay their work. The heart-wood is a light mahogany colour generally variegated with dark streaks. The wood, and especially the bark gives a black colour with the salts of iron. In many places thread and other stuffs are coloured black with a decoction of the bark of this as well as that of the red maple, and ink is made of it.

In the first volume of Tilloch's magazine is an account of the manufacture of sugar from the sugar maple in the middle states by the late Dr. Rush of Philadelphia, from which the following particulars are abstracted.

1. One tree yields from twenty to thirty gallons of sap in a season, which will make from five to six pounds of sugar, and in a single instance twenty pounds were made from one tree in a season.

2. One man made six hundred and forty pounds in four weeks.

3. A man and his two sons made eighteen hundred pounds in a season.

4. That the tree improves by tapping, affording more and better sap.*

5. The sugar is of a better quality than West-India sugar.

6. A farmer in North-Hampton county (Penn.) improved the quality of the maple sap by culture, so that he ob-

* According to my observations the sap improves in quality but is much diminished in quantity. L.

tained one pound of sugar from three gallons, while it required five or six gallons from a tree in its wild state.

7. That a few acres of land planted with maples and improved as a sugar orchard, would probably be more profitable than the same ground devoted to fruit trees.

8. That the buds and twigs of the sugar maple are used for food for cattle in the winter and spring.

I had for several years known that Fryeburg was celebrated in the adjoining country for manufacturing sugar. A few months ago I had occasion to visit the pleasant village in that town. On enquiring into the subject I learned the following particulars :

1. The sugar in Fryeburg is not made from the sugar maple but from the river maple, (*Acer eriocarpum*) which abounds there on the banks of the Saco.

2. About four gallons of sap afford one pound of sugar.

3. Two men in 1819 made twelve hundred pounds from two hundred and twenty-five trees, with two taps to a tree, equal to five and one third pounds to a tree.

4. The sap was generally said to be sweeter than that of the sugar maple.

5. A particular cluster of trunks springing apparently from the same root, tapped in several places afforded twenty gallons of sap in one day !

6. Those who make sugar from the sugar and river maples growing together, give the preference to the river maple.

7. The sugar is whiter and of a better quality than that of the sugar maple.*

8. A peculiar method of tapping is practised in Fryeburg. The incision from which the sap issues is made by driving a gouge a little obliquely upward, an inch or more into the wood. A spout or tap about a foot long, to conduct off the sap, is inserted about two inches below this incision with the same gouge. The two incisions are situated thus :  One principal advantage of this method is, that the wound in the tree is so small that it is perfectly healed or "grown over" in two years, the tree sustaining little or no injury. The other common methods of tapping are two. 1. With

* Michcaux says, that the sugar made from the river maple on the Ohio, is whiter and more agreeable to the taste than that from the sugar maple.

an axe. An oblique incision three or four inches long, is made in such a manner that all the sap will be conducted to the lower corner, where it passes into a spout inserted with a gouge as above. Disadvantages of this method. The surface being much exposed to the air and sun, is presently dried, so as to diminish very much the quantity of sap. The wound in the tree is extensive and a ruinous decay is often the consequence, the tree becoming rotten-hearted. 2. With an auger. The tree is peforated an inch or more with an auger three fourths of an inch diameter, and a tube made of elder or sumach is inserted to conduct off the sap. The end of the tube is made tapering so as to bear only at the outer edge of the tube. Disadvantage. The tap presses upon the external grains so as to obstruct the flow of sap from them; and it is from these *external* grains that most of the sap is obtained. The method of tapping with the gouge is undoubtedly superior to either of the others, but in a sugar maple there might be difficulty in inserting the gouge to a sufficient depth on account of its superior hardness.

9. The river maple grows about an inch in diameter in a year. This I ascertained by measuring the thickness of the concentric grains. There are several sugar orchards in Fryeburg which have grown up within twenty-five years to trees about five feet circumference, and from fifty to seventy feet high. The seeds are so abundantly distributed there by means of their peculiar wings that they spring up in the ploughed fields, on the sand flats, in the road, and in every place where they can take root.

It will be seen that in my account of the quantity of sugar made from a tree, &c. there is a singular coincidence with Dr. Rush's statements. This is altogether accidental for the quantity varies greatly in all trees according to their situation, age, the season and other circumstances. In some seasons only about a pound to a tree is obtained.

It seems that the superiority of the river over the sugar maple as a sugar tree is not universal; for Micheaux says, that on the Ohio only one half the quantity is obtained from the river, that is afforded by the sugar maple.

I have communicated this paper principally for the purpose of recommending the cultivation of the river maple as an ornamental tree, instead of others less beautiful and less useful. It seems to be adapted to this purpose, on account of its beauty, the rapidity of its growth and the fine sugar it affords.

Although the idea of Dr. Rush, that the United States might be more than supplied with sugar from the maple, and the quantity of human suffering consequently diminished, by rendering the employment of slaves in the West-Indies unnecessary, seems not likely to be realized, yet I think the cultivation of the maple ought not to be overlooked, especially as it might afford some supply in case the importation of sugar should, at any time, be interrupted by political disturbances.

The river maple would thrive best no doubt in a situation similar to that which it occupies in its native state, i. e. on the flats of clear streams. That it will grow however in other situations seems to be confirmed by the following facts. Micheaux states that " in Europe it is multiplied in nurseries and gardens. Its rapid growth affords hopes of cultivating it with profit in this quarter of the world."

Mr. Cook, Preceptor of Fryeburg Academy, informed me that he planted some of the seeds in his garden, which is on a dry elevated sandy plain, and raised trees from them, which grew so rapidly, and monopolized so much ground, that he found it necessary in a few years, to extirpate them.

Boston, April 20, 1820.

Art. XI. *On the Oriental Chené, and the Oil which it affords.*

Rocky-brook, 9th mo. 13th, 1820.

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE, &c.

I am induced to enquire of readers, and correspondents, to thy valuable miscellany, whether the Oriental Chené might not be more extensively cultivated in the United States for the purpose of extracting its invaluable oil? It is a species of sesamum, (class dydinamia, order angiospermia of Linnæus, Sesamum folius ovato oblongis integris of Miller—Digitalis orientalis, sesamum dicta—Tournefort,) and is thus described by Miller :—" This plant was introduced into Carolina by the African negroes, where it succeeds extremely well. The inhabitants of that country make an oil from the seed, which will keep many years, and not take any rancid smell or taste ; but in two years becomes quite mild, so that when the warm taste of the seed which was in the oil when first drawn, is worn off, they use it as a sallad oil, and for all the purposes of sweet oil."

A late writer, (Darby,) speaking of Louisiana, says it might indeed be made an universal object of culture. The seed vessel is a many seeded capsula, containing round oily seeds, which are used in various ways by the negroes, who cook it as a pulse. It has been long known to produce an oil, containing all the valuable qualities of olive oil, without the same liability of becoming rancid by age. The Chené is certainly one of the most productive vegetables that was ever cultivated by man. It is known in Louisiana, but much neglected. Being brought from the western coast of Africa, from the banks of alluvial rivers, its growth is luxuriant on the fertile borders of the Mississippi and Teche : it will also vegetate extremely well on a high dry soil."

I have been led to the foregoing enquiry from the supposition that such an oil would be a great acquisition on many accounts, and a knowledge that it may be applied to many useful purposes in *mechanics*. It is well known that a thin fat oil, which will bear exposure to heat, and air, without becoming rancid, for a great length of time, is the grand desideratum in Horology. Provided it is not glutinous, or too volatile, the spirit obtained by freezing and pouring off the thinner part that it may not be affected by cold, would have many advantages over the different kinds now in use, all of which are liable to become rancid, and of course, unsuitable for such purposes. The spirit of common olive oil is mostly used, but soon becomes unfit; and the objection is equally applicable to that obtained from spermaceti.—There have been several methods proposed for remedying this defect in oils, such as shaking them with pearlash water, or pouring melted led into them, etcetera ; all of which, on experiment, have been found objectionable; the first evidently extracts the thinnest, consequently richest and most valuable part, the last renders it acrid and empyreumatic.

W.

MATHEMATICS.

Art. XII. *Mathematical Problems, with Geometrical Constructions and Demonstrations, by* Professor Theodore Strong.

[Continued from page 64 of this Volume.]

Problem IX.

It is required through a given point to describe a circle which shall touch two circles given in position and magnitude.

Case I. When the two circles are unequal, and the circle which touches them does not circumscribe them.

Const. Let L (*Fig.* 1. *pl.* 2.) be the given point, and HB*c*, HG, E the given circles. It is required to describe through L, a circle which shall touch the two given circles. Join the centres x, y, of the circles HBC, DGE by xy, and extend xy till it meets FG, (FG being drawn, (Prob. vii. Case i.) touching the two circles,) in A. Let xy extended, cut the given circles in B, C, D, E. Through L the given point, and C, D, the two adjacent points, in which AE cuts the given circles, describe (Prob. i.) the circle LCD. Join LA, and suppose LA produced cuts LCD in K. Through the points L, K, describe (by Problem v.) a circle touching HBC in H. And this shall be the circle required.

Demonstrations. For join AH, and extend it till it meets the circle DG in I. It will meet this circle, because it cuts off similar segments from the two given circles, (Prob. viii.) And let AH meet the circle HLK in I′. Now by the property of the circle AL, KA=AC, AD. But AC, AD=A H, AI, (Prob. viii. Cor. 4.) Therefore AH, AI=AL, LK. But AL, AK=AH, AI′. Therefore AH, AI′=AH, AI. Hence (striking out AH) AI=AI′. Wherefore the points I′, I coincide. Therefore the circle LKH, meets the circle DG, E in I.

It also touches it in this point; for if the line MO be drawn touching KLH, BRH in H, and the line No. 2 touching the circle LHI in I, then the angle RHM=angle in the segment RBH, and the angle IHO=RHM=angle in the segment HLKI. But the angle in the segment RBH= angle in the segment IDEP. Therefore the angle in the segment IDEP=angle in the segment HLKI=angle HIQ, or NIP. Whence the angle in the segment IDEP=NIP; wherefore NQ touches DEPI in the point I. Consequently, HLKI touches IDEP in I. Now (by Const.) HLKI touches RBH, and passes through L. Wherefore it is the circle required.

Case II. When the two circles are unequal, and the circle which passes through the given point circumscribes them.

Const. Let *(Fig. 2. pl. 2.)* as in Case i. the point be L, and the circles HBC, DGE. Draw the tangent FG, and extend it till it meet xy, produced in A. Let xy produced cut the given circles in C, B, E, D. Through L, and C, D, the remote points in which xy cuts the given circles, describe (Prob. i.) the circle LCD. Suppose AL produced to meet the circumference of this circle in K. Through the points, K, L, describe (Prob. v.) a circle touching HBC, in H. Then shall this be the circle required.

The points AI′, AI being joined as in case I. and the tangents MO, NQ being drawn, the demonstration employed in case II, is applicable to this.

Case III. When the touching circle circumscribes one of the given circles, and touches the other externally.

Const. Let *(Fig. 3. pl. 2.)* HBC, and HGE be the given circles, and L the given point. Join xy, the centres of the circles, and extend this line till it cut the circumferences of the circles in B, C, D, E. Draw FG, a tangent to the circles in the points F, G. Let this cut the line, CE in A. Join AL. Through L, C, D, describe the circle L CD. Suppose AL extended cuts this circle in K. Through L, K, describe the circle LKH touching BHC in H. Join AH, and let A H produced cut DGE in L, and HKL in I′. Draw, as in cases I and II, MHO touching the circles HKL, BHC, in H, and NQ touching HKI′L in I′.

Now by applying the Demonstration in case I, the circle HKI′L, as in former cases will be found to answer the conditions of the problem.

Case IV. When the two circles are equal, and the touching circle circumscribes both or neither of them.

Const. Let (*Fig.* 4. *pl.* 2.) CKL, BMN be the given circles, and A the given point. From A as centre with radius = radius of the given circles, describe IQ. Then through x, y, the centres of the given circles describe the circle I + y touching IQ in the point I. Let O be the centre of this circle. From O as centre, and (in *Fig.* 1.) O I + IA as radius describe the circle CAB, which shall be the circle required.

Dem. For join OyB = OI + IA. Therefore the circle ABC meets the circle MN, in the point B. But it likewise touches this circle in the point B. For at B draw FG at right angles to OyB. Because this line is at right angles to the diameter of ABC in the point B, it touches this circle in the point B. For the same reason, it touches MN in B. Therefore the circle ABC touches the circle MN in the point B. In like manner it may be shown, that ABC touches KLC in the point C, and it passes (by Const.) through A. ABC is therefore the circle required.

Now (*Fig.* 5. *pl.* 2.) by using OI − IA for OI + IA, the construction and demonstration employed in Fig. 4, are applicable to Fig. 5, in which the given circles are neither of them circumscribed by the touching circle.

Cor. 1. In Case I, when the given circles touch, that is, when C, D coincide, the circle LCD must be described touching AE in the point of coincidence of C, D, after which, the construction and proof are as before.

Cor. 2. In Cases I, II, if the two circles cut each other, the solution remains the same; for it is independent of the distance of their centres. But in Case III. when the circles cut each other, the problem becomes impossible. When they touch, the circle touching them must pass through the point of contact of the two circles.

Cor. 3. Case IV, may be considered as falling under Cases I, II, when the point A (See Fig. Cases I, II.) becomes infinitely distant. But in Case III, the construction remains the same, whatever be the magnitude of the circles. For there the point A is confined between the centres of the circles.

Cor. 4. In Case I, if the given point fall in the line AE between the points C, D, as in r, make the rectangle Ar.

$Az = AC . AD$. Then $AD : Az :: Ar : Ac$. But $Ar > AC$ therefore $AD > Az$, therefore the problem is possible, for the point z always falls between C and D. Having determined the points r, z, use them in the same manner as the points C, D were used, and the solution is the same as before.

Cor. 6. In Case III. when the point is between B and D as r, then making the rectangle $Ar . Az = AD\ AC$, the point z will fall beyond C; and therefore the problem is possible. Using then the points r, z for C, D, the solution remains the same. On the contrary when the given point is beyond C, r will be between D, and B. Then proceed as before.

Note.—When the circles do not cut, and one does not fall entirely within the other, the point cannot be given within one of the circles, but must be without the circle, or in the circumference of one of them; and then the solution will fall under one of the above cases; when the circles cut each other, the point may be given any where, except at the points of intersection of the circles; when one of the circles falls wholly within the other, the point must be given between the circumferences of the two circles; in all which cases, the construction may be referred to one of the above methods.

Problem X.

To describe a circle to touch three circles given in position and magnitude.

Case I. When the three given circles are equal, and the touching circle comprehends them all, or none of them.

Const. Let (*Fig.* 6. *pl.* 2.) DD′, EE′, FF′, be the three given circles, it is required, to describe a circle which shall touch all of them. Let A, B, C be the centres of the given circles respectively. Through A, B, C, describe the circle ABC, (Prob. I.) of which let O be the centre. From O as centre, with $OA + AD$ as radius describe the circle DEF, which shall be the circle required.

Demonstration. For, join OAD. Now $OAD = OA + AD$. Therefore the point D is in the circumference of the circle DEF. In like manner the points E, F, are in the circumference of the same circle. But the circle DEF likewise touches the three given circles. For at the point F, draw G, H at right angles to OF, and it will be a tangent to the circles DEF, F, F′ at the point F. Therefore the circles touching the line GH at the same point F, touch each other at that point. In like manner it may be proved, that the circle DEF touches the other two circles at E, D, respectively.

Now by using OA−AD for OA+AD, &c. and D′, E′, F′, &c. for D, E, F, &c. this construction and demonstration are applicable to the case in which none of the given circles are comprehended by the touching circle.

Case II. When the circles are equal, and the touching circle circumscribes one, and touches two, or circumscribes two and touches the other.

Const. Let (*Fig.* 7. *pl.* 2.) Ey, Dx, Fz be the given circles of which A, B, O are the centres. From O, the centre of the circle Fz, describe the circle GLM, with radius=Q radius of the given circles. Through the points A, B, describe the circle ABG touching GLM (Prop. v.) in the point G. Let C be the centre of ABG. Then from C as centre, and CG−FO as radius, describe the circle D EF, which shall be the circle required.

Demonstration. For join C, O the centres of the circles ABG, GLM. Extend *co*, and it will pass through the point of contact of these circles. Join also CEA, CDB. Now because CE=CA−AE the radius of the given circles, E is in the circumferences of the circles Ey, DEF, and if at the point E a line be drawn at right angles to CA, it will be a tangent to the circles Ey, DEF at the same point E. Therefore these circles touch each other at the point E. In like manner it may be proved that the circles Dx, DEF touch each other in the point D, and that Fz, DEF touch each other in the point F. Therefore DEF is the circle required.

By using CA+AE, &c. for CA−EA, &c. This demonstration is applicable to the Fig. in which the touching circle comprehends two of the given circles, and touches the other.

Case III. When two of the circles are equal.

1. When all the circles or none of them are comprehended.

Const. Let (*Fig.* 9. *pl.* 2.) ALA′, BMB′, CNC′, be the given circles, of which ALA′, BMB′, are equal, and CNC′ is less than the other two. Let G, H be the centres of ALA′, BMB′, From G, H, as centres, with radius = radius of ALA − radius CNC, describe the circles DD′, EE′. Through F the centre of the circle CNC′, describe the circle FDE, (Prob. IX.) touching DD′, EE′ in D, E, of which circle, let O be the centre. Join CD, and it will pass through G. Then from O as centre, with radius = OD + CF (= radius of the circle CNC′) describe the circle ABC, which shall be the circle required.

Demonstration. For join ODA. Now because ODA = radius of the circle ABC′ (= OD + DA, or FC) of which O is the centre, A is in the circumference of ABC. And because ODA passes through G, and GD + DA = radius of the circle ALA′, A is in the circumference of ALA′. Hence ALA′, ABC meet in A. And they likewise touch in A. For if Ax be drawn at right angles to ADO, A will be a tangent to both circles in the same point A. Whence the circles must likewise touch in that point. In like manner it may be proved that ABC, BMB′, ABC, CNC′, touch each other respectively at the points B, C. ABC is therefore the circle required.

Now by using OD′ − AD′ for OD + AD, and A′, B′, &c. for A, B, &c. the demonstration is the same when none of the given circles is comprehended.

2. When the touching circle comprehends both the equal circles, and touches the smaller one externally; or comprehends the smaller circle, and touches the equal circles externally.

Construction. Let (*Fig.* 10. *pl.* 2.) Gy, Fx, Iz, be the given circles of which Gy = Fx. Let A, B, C be the centres of these circles respectively. From A, B, as centres with radius = radius of the circle Gy + radius of the circle Iz describe the circles Dg, Fn. And through C, the centre of the smaller circle, describe a circle CDE touching the circles Dg, Fn, in the points D, E, of which circle let O be the centre. From O with radius = radius of the circle CDE − radius of the circle Iz, (i. e. OD − GD, or CI,) describe the circle GIF, which shall be the circle required.

Demonstration. For join OD, OE, which will pass through e centres A, B. Now (by Const.) D is in the circumferences DCE, gD. Therefore since OG=OD−GD, or OD−CI, and AG=AD−CI, G is in the circumferences of GIE, Gy; and if at G a line be drawn at right angles to OG, it will touch both circles at the same point G. Therefore they touch each other at the point G. In like manner Iz, GIE; Ex, GIE touch respectively in I and E. Wherefore GIE is the circle required. Now by using OD+GD for OD−GD, the demonstration is the same in Fig. 11.

3. When the touching circle circumscribes one of the equal circles alone, or one of them together with the smaller one.

Construction. Let (*Fig.* 12. *pl.* 2.) Eg, Hz, Bx, be the given circles, of which A, F, C, are the centres. From F as centre with radius=radius circle Hz−radius of the circle Bx (i. e. FH—BA) describe the circle Gy. And from C as centre with radius=radius of the circle Hz or Eg+radius of the circle Bx describe the circle Dn. Then describe through A the centre of the circle Bx, the circle AGD, (Prob. V.) touching (*Fig.* 13. *pl.* 2.) Dn, Gy in D, G; of which circle let O be the centre. From O with radius =radius of the circle AGD−radius of the circle Bx describe the circle HEB, which shall be the circle required.

Demonstration. For join OHG, OCED, OBA. The line OHE will pass through G, the point of contact of the circles Gy, GAD. Now because GH=BA and OG−BA=OH, the point H is in the circumferences of the circles Hz, HEB. And if a line be drawn at right angles to OG at the point H, the circles Hz, EHB will touch it at the same point H. Therefore they touch each other at that point. In like manner it may be shown that the circles Bx, BHE, Eg, EHB touch each other respectively at the points B, E. Therefore EHB is the circle required.

If instead of OG−BA, OG+BA be used, this demonstration is applicable to Fig. 13, in which one of the equal circles, and the smaller one are comprehended by the touching circle.

4. When the two equal circles are less than the other, and when the touching circle comprehends all or none of the given circles.

Construction. Let (*Fig.* 14. *pl.* 2.) DND′, EME be the two equal circles, of which x, y, are the centres, and A

LA′ the other whose centre is G. From G as centre with radius = radius of the circle ALA′ − radius of the circle EME, describe the circle BB′g. Then through the points x, y, describe the circle xBy touching BB′g in B, (Prob. III.) of which circle let O be the centre; increasing the radius by a line = radius of the circle EME, describe the circle ADE, which shall be the circle required.

Demonstration. For join OBA which will pass through G the centre of the circle BB′g. Now because OA = OB + BA and GA = GB + BA, A is in the circumferences ALA′, ADE. Hence if a line be drawn at right angles to OA at the point A it will be a tangent to both circles at the same point A. Hence the cicles ALA′, ADE touch each other at the point A. In like manner it may be proved, that the circles DND′, ADE′, EME′, EAD, touch respectively at D, E.

By joining O′A′B′, and using A′B′, &c. for A, B, &c. and O′B′ − O′A′ for OB + AO the demonstration is the same when the circles are none of them comprehended.

5. When the touching circle comprehends both of the equal circles; and touches the other externally, or comprehends the larger and touches the other externally.

Const. Let *(Fig. 15. pl. 2.)* ML, xI, Hy be the given circles of which Hy=Ix. Let A, B, C be the centres of these circles. From the centres C, B with radius=radius of the circle Hy+radius of the circle ML describe the circles EN, DP. Then through A describe the circle AED touching EN, DP in E, D, of which let O be the centre.

From *(Fig. 16. pl. 2.)* O as centre with radius=radius of the circle AED—radius of the circle Hy describe the circle LHFI, which shall be the circle required.

Demonstration. For join OCE which as before shall pass through the centre C. Let it cut the circle Hy in H. Then because OH=OE—HE or the radius of the circle LMH is in the circumference of the circle HFI. Therefore if a line be drawn perpendicular to OC at the point it will be a tangent to both circles Hy, HIF at the point H. The circles therefore touch at the point H. In like manner it may be shown that the circles Ix, HFI; ML, HFL touch respectively at the points I, L. HFI is therefore the circle required. By using EO+EH for OE—EH this demonstration answers for Figure 16, in which the larger circle is alone comprehended.

6. When the touching circle comprehends one of the equal circles, together with the larger, or one of the equal circles alone.

Const. Let *(Fig. 1. pl. 3.)* HPN, MGQ, DER be the given circles of which DER=MGQ. Let A, B, C, be the centres of these circles respectively: From A with radius =radius of the circle HPN+radius of the circle DER describe the circle IK: and from B with radius=two radii of the circle MGQ describe the circle FL. Through C describe the circle CFI touching IK, FL in the points I, F; of which circle let O be the centre. Decreasing the radius by a line=radius of the circle DER describe the circle HE G which shall be the circle required.

Demonstrations. For join OC. Let OC cut the circle DER in the point E. Now because OE=OC—CE, E is in the circumference of the circle HEG. If therefore *(Fig. 2. pl. 3.)* as in former cases, a perpendicular be erected at E, it will touch both circles at that point. Therefore the circles DER, HEG touch each other in the point E. In like manner it may be shown that the circles HPN, HEG; GQM, HEG respectively touch at the points H, G. Therefore HEG is the circle required.

By using OC+CE for OC—CE this demonstration is applicable to Fig. 2, in which the touching circle comprehends one of the smaller circles and touches the other, together with the larger circle externally.

Case III. When all the circles are unequal,

1. When the touching circle comprehends all or none of the given circles.

Cons. Let *(Fig. 3. pl. 3.)* AL, HN, MF be the given circles of which FM is the least. Let B, K, E, be three centres. From B describe the circle DG whose radius=radius of the circle AL—radius of the circle FM. From K describe the circle IP, whose radius=radius of the circle NH —radius of the circle FM. Through E describe the circle EDI touching DG, PI in D, I. (Prob. V.) Let O be the centre of this circle. From O, with radius=radius of the circle DEI+radius of the circle FM, describe the circle AFH, which shall be the circle required.

Demonstration. For join ODA which will pass through the centre B. Now because OA=OD+EM and BA=DB+EM, (if M be the point in which a line joining O, E, cuts the circle FM) A is in the circumferences of AL, AFH. And if at A a perpendicular be erected both circles will touch it at the same point A. Therefore they touch each other at that point. In like manner it may be shown that NH, AFH, MF, AHF respectively touch at the points H, E. Therefore AFH is the circle required.

By using OD—EM for OD+EM this demonstration is applicable to fig. 4, in which none of the circles are comprehended by the given circle.

2. When the touching circle comprehends and touches one externally or comprehends one and touches two externally.

Cons. Let *(Fig. 5. pl. 3.)* HK, GM, LE, be the given circles whose centres are A, B, C. Let EL be the circle which is not to be circumscribed alone. From A with radius=radius of HK+radius of LE describe the circle DI. And from B with radius of MG,+radius of LE, describe the circle FN. Through C describe the circle DCF touching DI, FN in D, F,—of which circle let O be the centre. Decreasing the radius of this circle by a line=radius of the circle LE (or in Fig. 6. increasing it by the same line) describe the circle HEG, which shall be the circle required.

Demonstration. For join OC and it will cut the circle LE in the point E. Because OE=OC—CE, E is in the circumference of HEG. Therefore if from E a perpendicular be erected, it will touch both circles in the same point E. Therefore they touch each other in that point. In like manner the circles G, M, HEG; HK, HEG, touch respectively at H, G.

Now by using OC+CE for OC—CE this demonstration applicable to Fig. 6. pl. 3. in which one circle is comprehended and the other two touched externally.

Problem XI.

It is required to draw a circle through a given point, to touch a straight line given in position and a circle given in magnitude and position.

Case I. When the given circle is not comprehended.

Const. Let *(Fig. 7 pl. 3.)* AB be the given straight line, H the given point and DIKE the given circle. It is required to describe through H, a circle to touch the given line and circle. Let C be the centre of DIKE. From C draw CF at right angles to AB, cutting the circumference of DIKE in E, D. Through F, E, H describe the circle FEH *(Prob. I.)* join DH. Suppose DH produced to cut the circle FEH in G. Through GH describe the circle HGL to touch AB in L *(Prob. III.)* and this will be the circle required.

Demonstration. For join OL. Let OL cut the circle LGH in K and DIK'E in K'. Now DE, DF=DH, DG =DK, DL. If EK' be joined, (Plaf. Euc. 6. prop. L,) B E, DF=DL, DK'; but BE, DF=DL, DK therefore DL. DK=DL, DK'. Hence KD=DK'. Therefore the circles DIKE LKG meet in E. But they likewise touch in that point. For if they do not they must meet in some other point. Let them meet in x. Join Dx and extend it to cut LHG in y, and AB in z. Then as before, (Euclid. 6. p. I,) Dx, Dz=DE, DF=DL, DK=Dx, Dy. Therefore since Dx, Dz=Dx, Dy, Dz=Dy, the less to the greater which is absurd. Therefore the circles do not meet in any point but K. Wherefore they touch in that point. But (by Const.) GKL touches AB and passes through H. G KL is therefore the circle required.

Case II. When the given circle is circumscribed.

Const. Let *(Fig. 8. pl. 3.)* AB be the given line, DIEK the given circle and H the given point. From C the centre of DIEK draw CF perpendicular to AB, cutting the given circle in D, E of which E is not adjacent to the straight line. Through F, E, H describe the circle FEH. Join HD. Let HD extended cut FEH in G. Through G, H describe a circle touching AB in the point L. and this will be the circle required.

Demonstration. For join LD extended let this line cut LGH in the point K and EDI in the point K'. Now FD, DE=LD, DK. But if KE be joined the angle DKE is a right angle, and the angles KDE and FDL are equal. Therefore FD : LD : : K'D : : DE, whence FD, DE=L D, DK' which therefore is equal to LD, DK. Hence D K'=DK and the points K', K, coincide. Therefore the circles HGL, DIE meet in K. They also touch in that point. For if they do not they must meet in some other point; let them meet in x. Join Dx. Let Dx produced cut HGL in y and AB in y. Then Dy, Dx=LD, DK. But DxE being a right angle as before, Dx, Dz=FD, DE=LD, DK. Therefore Dx, Dy=Dx, Dz and Dy=Dz which is absurd. Therefore the circles do not meet in x. Now x being any point they meet in no point but K. They therefore touch in K. Wherfore LGKH is the circle required.

Case III. When the given circle cuts the given straight line.

Const. Let *(Fig. 9. pl. 3.)* AB, be the given straight line, H the given point, and FD′E the given circle. Let the circle FD′E cut AB in L, M. Through C the centre of the given circle draw CI at right angles to AB in I. Let this line produced cut the circle FD′E in E, F. Through H, I, E describe the circle HIF. Join EH. Let this produced cut G, HIF in G. Through H, G describe the circle GHOD touching AB in O. And this will be the circle required.

Demonstration. For join OE, let EO extended cut E D′F in D′ and GHOD in D. Then (E. 6. p. I.) EO, E D′=EI, FE=EH, EG=EO, ED. Therefore since EO, ED=EO, ED′, ED=ED′, and the circles FD′E, GHOD meet in D. But they also touch in this point. For if not, let them as before meet in x. Join Ex cutting AB in y, and GHOD in z. Then joining Fx, the angle ExF is a right angle. Therefore EI : Ez : : Ex : EF wherefore E I, EF=Ez, Ex. But EI, EF=EO, ED=EH, EG=Ey, Ex. Therefore Ex, Ez=Ex, Ey, and Ez=Ey which is absurd. Therefore the circles FDE, GHOD do not meet in x. Now x being any point but the point D, they meet in no point but D. They therefore touch in D. Therefore GHOD is the circle required.

Note.—When the circle does not cut the line, the point must be given without the circle and on the same side of the line with the circle. When the circle cuts the line the point may be given any where except at the point of intersection of the line and circle. If the circle to be described is to touch the given circle externally, the point may be given any where without the circle or in the circumference, except in the points E, F, (see Fig. Case III.) which are respectively equi-distant from the points of intersection of the given circle and line.

Problem XII.

It is required to describe a circle to touch a straight line given in position, and two circles given in position and magnitude.

Case I. When the touching circle circumscribes both the given circle and touches the straight line, or circumscribes neither of the given circles and touches the given straight line.

Const. Let *(Fig.* 10, *pl.* 3.*)* AB be the given straight line, GQS, MPO, the given circles, it is required to describe a circle to touch at B and likewise touch the circles GQS, MPO. Let I and N be the centre of the given circles. From I, with radius=radius of QGS—radius of MPO (if GQS > MPO) describe the circle HRK. Draw also the line CD parallel to AB, and distant from it by a line=radius of the circle MPO. Then through N describe the circle NHF touching HRK in H and CD in F. Let L be the centre of this circle. From L with radius=radius of the circle HFN+radius of the circle MPO describe the circle EGO, which will be the circle required.

Demonstration. For join LHG which will pass through I. Now because LG=LH+radius of the circle MPO and IG=HI+radius of the circle MPO, G is in the circumferences of EGO, SGQ. And if at G a perpendicular be erected, it will touch both circles EGO, SGQ at the point G. Therefore these circles touch each other at the point G. In like manner it may be shown that the circles EGO, MPO touch at the point O. But EGO likewise touches the straight line AB. For join LFE. Let this line cut the circle EGO in E. Now because LE=LF+radius of the circle MPO, the point E falls in the line AB. And because AB and CD are parallel ∠LEA=∠LFC. But ∠LFC is a right angle—(F being the point of contact of the circle FHN and line ED) Therefore LEA is a right angle, and consequently AEB touches EGO in E, wherefore EGO is the circle required.

By using LE+radius of MPO for LE—radius of MPO, this demonstration is applicable to Fig. 11, when neither of the circles is comprehended.

Case II. When the touching circle comprehends one of the given circles.

Const. Let *(Fig.* 12. *pl.* 3.) AB be the given straight line and QHP, LRS the given circles, of which LRS is to be comprehended by the touching circles. Let G, K be the centres of the given circles respectively. From G with radius equal to the radius of HPQ + radius of LRS describe the circle NMI. Draw also CD parallel to AB and distant from it by a line = radius of the circle LRS. Through K describe the circle KFI touching NIM in I and CD in F, of which circles let O be the centre. Increasing the radius by a line = radius of the circle LRS describe the circle LE H, which will be the circle required.

Demonstration. For join OIH, OKL, OFE: let OIH cut QPH in the point H. Now because OH = OI + radius of the circle LRS, H is the circle LHE; and if at the point H a line be drawn perpendicular to OH it touches the circle LHE at the point H, it will likewise touch QHP in H. For if the line OH be extended it will pass through G the centre of QHP. Therefore QHP, LEH touch each other at H. In like manner LRS, EHL touch each other at L. But the circle LEH touches AB. For let OFE cut EHL in E. Now the angle OFC being right OF will cut AB at right angles. And because OE = OF + radius of LRS, E falls in the straight line AB. But it has been proved that OFE cuts AB at right angles. Therefore AB touches EH L at E. Wherefore EHL is the circle required.

Note.—The circles must always be on the same side of the line; when they cut the line the touching circle cannot circumscribe them. When one of them lies wholly within the other the given line must cut one or both of them: otherwise the problem is impossible.

Problem XIII.

There are two points and a straight line given in position, it is required to draw from the points to a point in the straight line, two lines whose differences shall be equal to a given line.

Const. Let *(Fig.* 13. *and* 14. *pl.* 3.) AB be the given line, C, D the given points and X the given difference. From C as centre with radius = X describe the circle LIO.

Through D draw DE perpendicular to AB, and extend it till EG=DE. Through D, G describe a circle IDG touching LIO in I. The centre of this circle is in the line AB, for the chord DG is bisected at right angles by AB. Let F be the centre. Then F is the point to be found.

Demonstration. For join FD, FC. Now the line FC will pass through I the point of contact of the circles LIO, IGD. Then, FC=FI+IC, and FC—ED=CI. But CI=x and FI=FD; therefore FC—FD=x, as was required.

Problem XIV.

There are two points and a straight line given in position, it is required to find a point in the straight line, such that the sums of the lines drawn from given points to this point shall be equal to a given line, this line never being less than the line joining the two points.

Const. Let (*Fig.* 15. *and* 16. *pl.* 3.) AB be the given line and C, D the given points it is required to find a point in the given line such that the lines drawn from the given points to that point shall together be equal to a given line. Draw DH at right angles to AB and extend it, till HF=DH. From C with radius=the given sum describe the circle EB I. Through (P. III,) D, E describe the circle DEF touching EBI in E. Now because DF is bisected at right angles by AB, the centre of DEF falls in BA. Let G be the centre then G is the point required.

Demonstration. For join CG which extended will pass through the point of contact of the circles DEF, BEI. Join also GD. Now CE=CE+GE=CG+GD. But CE=the given line. Therefore CG+GD=the given line as was required.

CHEMISTRY, PHYSICS AND THE ARTS.

Art. XIII.—*Strictures on a publication, entitled Clark's Gas Blowpipe ; by* Robert Hare, *M. D. Professor of Chemistry in the medical department of the University of Pennsylvania, and the real inventor of the compound or hydro-oxygen blowpipe, in that safe and efficient form by which the fusion of the most refractory earths, and the volatilization and combustion of Platinum was first accomplished.*

Hos ego versiculos feci, tulit alter honores,
Sic vos non vobis nidificatis aves,
Sic vos non vobis Vellera fertis oves,
Sic vos non vobis melificatis apes,
Sic vos non vobis fertis aratra Boves.
Virgil.

Dr. Clark has published a book on the Gas Blowpipe, in which he professes a "sincere desire to render every one his due." That it would be difficult for the conduct of any author to be more discordant with these professions, I pledge myself to prove in the following pages, to any reader whose love of justice may gain for them an attentive perusal.

In the year 1802, in a memoir republished in the 14th Vol. of Tilloch's Philosophical Magazine, London, and in the 45th Vol. of the Annales de Chimie, I had given the rationale of the heat produced by the combustion of the aeriform elements of water, and had devised a mode of igniting them free from the danger of explosion. I had also stated in the same memoir that the light and heat of the flame thus produced were so intense, that the eyes could scarcely sustain the one, nor the most refractory substances resist the other, and had likewise mentioned the fusion of the pure earths and volatilization of the perfect metals as among the results of the invention.

Subsequently in the first part of the 6th Vol. of American Philosophical Transactions, an account of the fusion of strontites, and the volatilization of Platinum, was published by me.

About the same time my experiments were repeated before Dr. Priestly, who gave them the credit of being quite original.

Some years afterwards Mr. Cloud of the United States mint, who has distinguished himself by the discovery of palladium in gold, having purified platina, so as to make its gravity equal to 22, requested me to subject it to my blowpipe. In the presence of this gentleman, I was completely successful in dissipating a portion of this pure metal. He was so much pleased with my experiments that he made an apparatus for himself, simplifying that part which was employed for holding the aeriform agents, by the omission of some appendages which were not necessary to his purpose.* Thus modified, my apparatus was introduced into use by Mr. Rubens Peale; and has for about ten years been employed by him, to amuse visitors at the celebrated museum established by his father in Philadelphia.

It appears by the testimony of Professor Silliman and others, that Dr. Hope had during his lectures at different times within a period of eight years, employed my blowpipe and awarded the invention of it to me. A reference to the third edition of Murray's chemistry, published before Dr. Clark professes to have attended to the subject, will demonstrate the impressions of the author of that work as the results of my experiments which I had published, are there quoted solely on my authority.

The memoir of Professor Silliman, read before the Connecticut Academy of Sciences, May 1812, and republished lately in Tilloch's Magazine, but which Dr. Clark has not *ventured* to notice, affords the most unanswerable evidence that we had anticipated him in almost every important experiment.

Mr. Reuben Haines, corresponding secretary of the Academy of Sciences, informed me in 1813, that in the laboratory of Dr. Pursh in this city, a mixture of the gaseous elements of water had been inflamed while issuing in a stream from a punctured bladder previously filled with them and duly compressed. Any relaxation of the pressure was of course productive of an explosion. He on the other hand recollects that at that time I proposed this mode of supply-

* It has been erroneously alleged that he simplified the blowpipe.

ing the blowpipe, interposing a small receptacle (like a water valve) between the reservoir and the place of exit. Cares more imperious prevented the execution of a plan which did not promise to be better than that I had before pursued successfully.

Some time afterwards Sir Humphrey Davy's discovery of the influence of narrow metallic apertures in impeding explosions, encouraged Dr. Clark and others to hazard the use of a mixed stream of hydrogen and oxygen gas, ignited while flowing from a common recipient, instead of allowing them as I had done, to mix only during their efflux. There is another immaterial difference in the modes of operating. In mine, hydrostatic pressure is employed to expel the gases from a vessel into which they are introduced as generated, or by means of a bellows. In the new mode, being pumped into the recipient by one aperture, they flowed out at another in consequence of their elasticity.

Dr. Clark pretends that the process he has employed is the best; admitting this, would it afford him any excuse for taking so little notice of mine, or attributing the discovery of it to others, especially while professing to give a *fair history* of the invention.

If I may be allowed to compare small things with great, when Mr. Cruikshank and Sir H. Davy improved the galvanic apparatus by introducing the trough, or modifying and enlarging it, did they on that account forget that Volta was the inventor of the pile? was it not still (though no longer a pile) called the Voltaic apparatus?

Dr. Clark, like many others of the same character, finding that he cannot prove himself and his associates to have the merit of originality, endeavours to deprive the real author of it, and accordingly ascribes it to Lavoisier. Had this been stated in his first papers, his motives had been less questionable. But why does he not refer to his authorities? In other cases he is very particular in making such references.

We all know that with a view to recompose water, Lavoisier caused the gaseous constituents of this fluid to burn within a glass globe, into which they entered by orifices *remote* from each other; but if he ever caused them to burn at a common orifice in the open air for the purpose of producing heat, wherefore is Dr. Clark the first and only person to communicate the fact to the publick? How does it happen that there is no account of the invention nor of any results obtained by it either in the elementary treatise of that great man, or in any of the cotemporary scientific journals. On the contrary, in the Elements just alluded to, Lavoisier treats of the heat produced by oxygen gas, and carbon, as the highest that art could produce.*

Dr. Clark informs us that Dr. Thomson, now Professor of Chemistry at Glasgow, made experiments with the mixed gases seventeen years ago, but was induced to abandon the undertaking, in consequence of accidents that happened to his apparatus. Can any thing more fully display unfairness, than that abortive experiments, made subsequently to those in which I was successful, should be adduced as subversive of my pretensions?

Dr. Clark states that the Americans claim the invention on account of experiments made by me in 1802. They were published in 1802; my apparatus and my first experiments were made in 1801.

Had Lavoisier, or any other person, availed himself of the heat produced by the union of the gaseous elements of water, how could the sagacious Dr. Thomson fail in his efforts to retrace a path so well and so recently trodden: or if deriving any advantage from the experiments either of the French philosopher, or those which he so imperfectly tried, why did he conceal it when occupied during so many years in communicating to the world all his chemical knowledge in five successive editions of his system?

So far were Dr. Thomson's experiments, or his knowledge on these subjects, from reaching the facts discovered by me, that he appears to have considered the authority of one name inadequate to establish what he vainly had endeavoured to effect. Hence, until plagiarism had given them a new shape, and perhaps a false gilding, they were totally overlooked in his compilations. He neither treated of the pure earths as susceptible of fusion, nor of platinum as susceptible of volatilization, until many years after I had proved them to be so, and promulgated my observations.

Dr. Clark gives himself great credit for having first pointed out the importance of employing the gases in such relative

* See plate, Fig. 10. (end of the volume.)

quantities as might enable them fully to saturate each other. To me it would seem, where the highest heat is desired, evidently absurd to employ them in any other way, because if either gas were present in too great quantity to be acted upon, the excess would be worse than useless. Is it not universally an object with chemists to use ingredients in the proportions in which they saturate each other, especially when within a given space and time the most intense reaction is to be induced? The author of this *professedly candid* publication would wish to convey the idea of my contrivance being so inferior in power to that adopted by him, that in a history of the invention, he does not deem it necessary to quote my experiments, but satisfies himself with obscure allusions to them, rather in a manner to derogate than to do justice. This procedure would be unjustifiable were the heat which he has produced decidedly greater than that produced by me. But the fact is otherwise. He fuses with difficulty Oolite, Iceland crystal, and pure native magnesia. The fusion of the best magnesia of the shops, and of quick lime from pure lime stone was among my first efforts, and was mentioned in a preface, omitted in republishing my memoir. Lately I have fused a piece of oyster-shell lime, which is perhaps as pure as any to be obtained by artificial purification.

Dr. C. has employed platina in some cases to secure refractory earths while exposed to the action of his instrument, although this metal, is dissipated by the heat of mine.

That in his inferences in respect to the decomposition of the earths, he did not anticipate Professor Silliman or myself, must be evident from the passages in our memoirs, which I shall presently quote. I doubt if time will shew that Dr. Clark has gone much beyond *the extent of our observations* on this subject.

But while the superiority of the temperature attained by mixing the gases before emission is thus questionable, there are great and undeniable advantages in having them propelled from different reservoirs. First, a degree of security from explosion, which cannot be attained with one common recipient.* 2d. The possibility of operating on a large

* Where the gases are kept unmixed in separate reservoirs, and meet only near the point of efflux in an orifice sufficiently large, as was the case with the original compound blowpipe, explosion is obviously impossible. If the

scale without danger. 3d. The power of varying the relative proportions of the gases so as to oxydate, or deoxydate, as may be desirable. This power is given by the common blowpipe, though in a different way, and is well known to be very useful.

To me it is ludicrous that the author should suppose any analogy to exist between the phenomena of the gas blowpipe, and those of volcanoes.

In order to put the gas blowpipe into operation, it is indispensable that there should be hydrogen and oxygen gases confined under moderate and equable compression, so as to flow out regularly from a common aperture, at which they may be ignited. How are these requisites to be obtained in nature? Whence the pure hydrogen or oxygen? Has Dr. Clark, or any other person, known them to be extricated in purity? Is not the former always carburetted or sulphuretted, and the latter never purer than in the atmosphere? When obtained by art, fire is requisite to liberate oxygen, but in nature the fumes of the fire would contaminate any gas which it might evolve; and it ought not to be forgotten that the circumstances which are favorable to the evolution of oxygen, are inimical to the liberation of hydrogen. Again, supposing the gaseous materials generated, where is the presiding demon with the genius to design, and skill to regulate that due admixture of them which the author exults in having discovered to be necessary, and granting that there could be in nature any competent substitute for human agency in a process so intricate, by what means, in operations so rude and extensive, is that retrocession of the flame to be prevented, to obviate which, in operating with his minute apparatus, a capillary tube has been found indispensable. In subterranean caverns, the gaseous elements of water might create explosions, but could never support the permanent heat requisite to fuse an

orifice be made smaller, and the gases mix at a greater distance from the place of efflux, valves should be interposed in the pipes, or the gases should be kept under equable pressure, as it is possible that if subjected to unequal pressure, the gas which is more pressed, may pass from one reservoir to the other, on leaving the cocks open accidentally. This, however, is an oversight not likely to take place, as it is so evidently accompanied by a waste of the gas, that an operator will hardly be so careless as not to close the cocks when the flame is not wanted. Closing them is in fact the usual mode of extinguishing the flame.

ocean of lava. The only difficulty this subject presents, is that of explaining the nature of volcanic fires, the incessant existence of which is self-evident. The access of the atmosphere is necessary to fire in all its ordinary forms. In that of volcanoes, it appears to subsist without any adequate supply of this principle. Dr. Clark, far from relieving us from this difficulty, has increased it, by alleging the necessity of another aeriform substance. A better solution, as I should suppose, was long ago afforded by a reference to the combustion of metals by sulphur, in the vapour of which some of them burn more readily than in the atmosphere. Lately the metallic origin of earthy matter being discovered, it has been supposed possible, that at some distance from its surface the globe may consist of a great metalloidal nucleus, which acting on water, may produce intense ignition. Those who have seen the consequences of moistening quick lime, may easily conceive that tremendous effects might ensue from reaction between water and calcium, or any of the same family of substances. In this case hydrogen would be produced, but there would be no oxygen.—Of the existence, however, of subterraneous fires in volcanic regions there can be no doubt, whatever may be the theory of their origin. The obvious proximity of springs, rivers, and even of the sea itself, with the well known force of steam, renders it easy to point out the proximate cause of earthquakes, or of volcanic explosions and eruptions, without calling in the gas blowpipe to our assistance.

That Dr. Clark could not without great injustice bring forward his mode of operating, otherwise than as another mode of doing what I had previously accomplished, nor his experiments, unless as an extension merely of the researches made by Professor Silliman and myself, will be perfectly evident, if it be considered that we all employed a flame of the gaseous elements of water, in the one case mixed during the efflux, in the other before; and that the most important results in both instances will, on comparison, be found nearly the same.

The mode of confining and propelling the gases through the pipe or pipes to the place of efflux, is irrelevant to the question. There are many methods by which this object may be accomplished. The principle of the apparatus used by Dr. C. will be found the same as that of the air vault employed in England to regulate the blast of large bellows at founderies and forges. Mr. Brook was the first to apply it to the regulation of a blowpipe, and published his account of it in April 8th, 1816.

I will proceed to quote and exhibit simultaneously, the observations and experiments of Dr. Clark, and of Professor Silliman and myself. As Tilloch's Philosophical Magazine is universally accessible, I shall refer to it for the memoirs of Silliman and myself: to vol. 14 for mine, to vol. 50 for his.* For Dr. Clark's experiments, commenced in 1816, I shall quote his book on the gas blowpipe, published 1819.

Experiments on Lime.

Hare, page 304. "Lime and magnesia are extremely difficult to fuse, not only because they are the most refractory substances in nature, but from the difficulty of preventing them from being blown on one side by the flame: nevertheless, in some instances, by exposure on carbon to the gaseous flame, small portions of these earths were converted into black vitreous masses. Possibly the black colour of these products of fusion, may have been caused by iron contained in the coal; for in the high temperature of the gaseous flame, a powerful attraction is exerted between iron and the earths."

Hare, page 306. "There is a peculiar species of native coal found on the banks of the Lehigh in this State, which is extremely difficult to ignite; which, when exposed to a high degree of heat and a copious blast of air, burns, yielding an intense heat without either smoke or flame, and leaving little residue. By exposure to the gaseous flame on this coal, both magnesia and lime exhibited strong symptoms of fusion. The former assumed a glazed and somewhat globular appearance, the latter became converted into a brownish semivitreous mass."

Silliman, page 109. "A piece of lime from the Carrara marble, was strongly ignited in a covered platinum crucible; one angle of it was then shaped into a small cylinder,

* These experiments were performed in December, 1811, and published in Bruce's Journal in 1812.

about one-fourth of an inch high, and somewhat thicker than a great pin. The cylinder remained in connection with the piece of lime. This was held by a pair of forceps, and thus the small cylinder of lime was brought into contact with the heat without danger of being blown away, and without a possibility of contamination. There was this further advantage (as the experiment was delicate, and the determination of the result might be difficult) that as the cylinder was held in a perpendicular position, if the lime did really melt, the column must sink and become at least to a degree blended with the supporting mass of lime. When the compound flame fell upon the lime, the splendor of the light was perfectly insupportable by the naked eye, and when viewed through deep coloured glasses (as indeed all these experiments ought to be) the lime was seen to become rounded at the angles, and gradually to sink, till in the course of a few seconds, only a small globular protuberance remained, and the mass of supporting lime was also superficially fused at the base of the column for a space of half an inch in diameter. The protuberance as well as the contiguous portion of lime was converted into a perfectly white and glistening enamel. A magnifying glass discovered a few minute pores, but not the slightest earthy appearance. This experiment was repeated several times and with uniform success; may not lime therefore be added to the list of fusible bodies?

Clark, page 47. "Lime in a state of perfect purity and in the pulverulent form being placed within a platinum crucible, and exposed to the flame of the gas blowpipe, its upper surface became covered with a limpid botyroidal glass, resembling hyalite; the inferior surface was quite black. Its fusion was accompanied by a lambent purple flame. This colour therefore may be considered as a characteristic hue of one at least of the oxydes of calcium."

Clark, page 49, No. 6. "Compact transition limestone (limestone of Parnassus.) The specimen was taken from the summit of Parnassus by the author. It was fused, but with great difficulty exhibiting after fusion a white milky enamel with points of intumescence that were transparent."

Experiments on Magnesia.

Silliman, page 110. "The same circumstances that rendered the operating upon lime difficult, existed in a still greater degree with respect to magnesia; its lightness and pulverulent form rendered it impossible to confine it for a moment upon the charcoal; and as it has very little cohesion it could not be shaped by the knife as the lime had been. After being calcined at full ignition in a covered platinum crucible, it was kneaded with water, till it became of the consistency of dough. It was then shaped into a rude cone as acute as might be, but still very blunt. The cone was three fourths of an inch long, and was supported upon a coiled wire. The magnesia thus prepared was exposed to the compound flame; the escape of the water caused the vertex of the cone to fly off repeatedly in flakes, and the top of the frustrum that thus remained gave nearly as powerful a reflection of light as the lime had done. From the bulk of the piece (it being now one fourth of an inch in diameter at the part where the flame was applied) no perceptible sinking could be expected. After a few seconds the piece being examined with a magnifying glass, no roughnesses or earthy particles could be perceived on the spot, but a number of glassy smooth protuberances whose surface was a perfectly white enamel. This experiment was repeated with the same success. May not magnesia then be also added to the table of fusible bodies?

Notwithstanding the previous publicity of these results obtained by my friend and myself, Dr. Clark in the following note, endeavors to convey an impression of the incompetency of my apparatus to fuse lime and magnesia. Note 5, page 46. "Professor Hare in America could not accomplish the fusion either of lime or magnesia by means of his hydrostatic blowpipe. See Annales de Chimie, tome 45 page 126." But why overlook Silliman's experiments. It is moreover strange that an English writer should refer his readers to the French Annales in preference to a London magazine, for a memoir which he knew to be published in both.*

*I mentioned above that I had lately fused a piece of oyster shell lime. It was exposed to the flame within an envelope of platina foil which was soon reduced to a fluid globule. The application of the heat being suspend-

CLARK. *Pure Oxide of Magnesium* (Magnesia.)

Fusion per se, extremely difficult. When the earth is made to adhere (by moisture with distilled water and subsequent desiccation) and placed upon charcoal it is fusible into a whitish glass; but the parts in contact with the charcoal acquire an imposing pseudo metallic lustre with a purple coloured flame.

CLARK. *Hydrate of Magnesia* (pure foliated Magnesia from America.)

" This substance is incomparably refractory; with the utmost intensity of the heat of the gas blowpipe, it is ultimately reducible to a white opake enamel invested with a thin superficies of limpid glass. Its fusion is accompanied with a purple coloured flame.

Experiments on Corundum.

Silliman, page 112. " Corundum of the East-Indies was *immediately* and *perfectly* fused into a grey globule." " Corundum of China the same with active ebullition."

Clark, page 56. Common corundum (greenish grey crystalized primary corundum from the East-Indies,) *fusible but with difficulty*, into a greenish coloured translucent glass nearly transparent, which at last becomes melted into a bead like form; or other wise exhibits upon its surface minute cavities caused by the escape of gas during its fusion. This gas is probably the same which pure silica more abundantly exhibits. A slightly coloured greenish flame accompanies the fusion of corundum."

Experiments on Sappar.

Silliman. " Sappar or kyanite perfectly and instantly fused with ebullition into a white enamel."

ed (when both substances had become cold.) This enabled me to make it receive the greatest heat of the flame on renewing the process. The lime then melted into a liquid, which subsiding round the globule of platina, caused it to appear after cooling as if set in enamel.

Clark, page 57. " This mineral owing to its refractory nature was used by Saussure as a supporter in experiments with the common blowpipe. It fuses very readily into a snow white frothy enamel."

Experiments on Zircon.

Silliman, page 112. Zircon of Ceylon, melted with ebullition into a white enamel."

Clark, page 58. " One of the most refractory substances, exposed to the heat of the gas blowpipe it becomes first opaque and of a white colour ; and afterwards its superficies undergoes a *partial fusion* and exhibits a white opaque enamel resembling porcelain.*

Experiments on the Spinelle Ruby.

Silliman, page 112. " Spinelle ruby fused immediately into an ellipitical red globule."

Clark, page 58. " Fuses readily and undergoes a partial combustion and volatilization with loss of colour and of weight. One of the solid angles of an octahedral chrystal was entirely burned off, and volatilized in one of these experiments."

Experiments on Silex, Alumine, Barytes.

Hare, page 304. " By exposure to the gaseous flame either on supports of silver or of carbon, barytes, alumine, and silex were completely fused. The products of the fusion of alumine and silex were substances very similar to each other and much resembling white enamel."

Silliman, page 109. " Silex, being in a fine powder it was blown away by the current of gas, but when moistened with water it becomes agglutinated by the heat and was then perfectly fused into a colourless glass."

Clark, page 59. " Pure precipitated silica (peroxide of silicium) becomes instantly fused into an orange coloured transparent glass. The colour may be due either to the

* I might say here with truth, Professor Clark in England was unable to fuse zircon in his mode of operating with the gas blowpipe.

charcoal serving as a support, or to the carbon of the oil used for making it into a paste.

On the reduction of the earths to the metallic state.

Hare, page 394. "The result of the fusion of barytes was a substance of an oak coloured cast, which after long exposure sometimes exhibited brilliant yellow specks. If it be certain that barytes is an earth, these specks must have been discoloured particles of the silver support, or of the pipes from which the flame issued."

Silliman, page 113. "During the action of the compound flame upon the alkaline earths provided they were supported by charcoal; distinct globules often rolled and darted out from the ignited mass and burnt sometimes vividly and with peculiarly coloured flame. From the nature of the experiments it will not be easy to prove that these globules were the basis of the earths, and yet there is the strongest reason to believe it. Circumstances could scarcely be devised more favorable to the simultaneous fusion and decomposition of these bodies; charcoal highly ignited for a support and an atmosphere of hydrogen also in vivid and intense ignition. That the oxygen should be under these circumstances detached is not surprising; but the high degree of heat and the presence of oxygen necessarily burn up the metalloids almost as soon as produced. If means could be devised to obviate this difficulty the blowpipe of Mr. Hare might become an important instrument of analytical research. We can scarcely fail to attribute some of the appearances during the fusion of the leucite to the decomposition of the potash it contains. This impression was much strengthened by exposing potash and soda to the compound flame with a support of charcoal; they were evidently decomposed; numerous distinct globules rolled out from them and burnt with the peculiar vivid white light and flash which these metalloids exhibit when produced and ignited in the galvanic circuit. It is hoped these hints may produce a further investigation of this subject. This communication has already been extended further than was contemplated; but on concluding, it may be allowable to remark that there is no body in all probability except a few of the combustible ones which is exempt from the law of fusion by heat."

Is there any apology for the manner in which Dr. Clark has brought himself and his friend before the public on this subject without the smallest acknowledgments for these suggestions?

Clark's Gas Blowpipe.

In proceeding to state the revival of two of the metals of the earths before the flame of the gas blowpipe, and of other metals under similar circumstances, it may be proper to prefix the ingenious theory of the Reverend J. Holme of St. Peters' College, Cambridge, respecting the cause of the decomposition that takes place. "It is entirely owing to the powerful attraction which hydrogen has to oxygen at such an exalted temperature." The reduction or decomposition of oxydes when exposed to the "gaseous flame"* is therefore often instantaneous, and it is as instantly followed by the combustion of the minute particles thus revived, and ultimately by the deposition of the regenerated oxyde which is a result of that combustion. Hence the coloured flame; hence also the appearance of an oxyde in a state of incomparably extreme division upon the supports used whether of metal or charcoal; an irrefragable test of the revival of the metal from whose combustion this newly formed oxyde has been derived.

Experiments on Strontites.

Hare, 1st part 6th Vol. American Philosophical Transactions, page 100, republished Annales de Chimie, Vol. 5, page 81. "About the same time I discovered strontites to be a fusible substance; for having obtained a portion of this earth pure, from a specimen of the carbonat of strontites of Argyleshire in Scotland, I exposed it on charcoal to the flame of the compound blowpipe after the manner described in my memoir above alluded to. It became fused into a blackish semivitreous mass in shape somewhat semi-globular."

* The very phrase used by me in my original memoir.

Clark. Here a different process is necessary ; the revival of the metal is rendered more difficult owing to the pulverulent state of the earth. The particles must be made to adhere before fusion can be accomplished, and this oxyde being much more refractory than the preceding is almost infusible per se even with the aid of the gas blowpipe." Thus he admits that a substance is almost infusible in his hands which has been repeatedly fused under mine.

Experiments and observations on the fusion, volatilization and combustion of the perfect metals.

Hare, page 305. "Had I sufficient confidence in my own judgment I should declare that gold, silver and platina were thrown into a state of ebullition by exposure on carbon to the gaseous flame ; for the pieces of charcoal on which they were exposed became washed or gilt with detached particles of metal in the parts adjoining the spots where the exposure took place. Some of the particles of the metal thus detached exhibited symptoms of oxidation."

Combustion of pure Gold.

Clark, page 90. "As this experiment affords decisive evidence of the *combustion* of *gold*, and of course its combination with oxygen, and also exhibits the oxyde under a very beautiful appearance, it may be considered as one of the most pleasing experiments with the gas blowpipe."

Experiments on Platinum particularly.

Hare, page 304. "Platina was fused by exposure on carbon to the combustion of hydrogen gas and atmospheric air. But the fusion of this metal was rapidly accomplished by the gaseous flame, either when exposed to it on carbon or upon metallic supports.

A small quantity of this metal in its native granular form being strewed in a silver spoon and passed under the gaseous flame, the tract of the flame became marked by the agglutination of the metal ; and when the heat was for some time continued on a small space, a lump of fused platina became immediately formed. About two penny weights of the native grains of platina when subject to the gaseous flame on carbon, became quickly fused into an oblate spheroid as fluid as mercury. This spheroid after being cooled was exposed as before; it became fluid in less than the fourth of a minute."

Hare, 1st part 6th Vol. Philosophical Transactions, page 99, republished Annales de Chimie, Vol. 60, page 81. "Being induced last winter to reinstate the apparatus by which these experiments were performed, I was enabled to confirm my judgment of the volatilization of platina by the observations of Dr's. Woodhouse and Seybert; for in the presence of these skilful chemists I completely dissipated some small globules of this metal of about the tenth of an inch diameter. In fact I found platinum to be equally susceptible of rapid volatilization, whether exposed in its native granular form, or in that of globules obtained from the orange coloured precipitate of the nitro muriatic solution by the muriat of ammonia."

Silliman, page 3. "Platinum was not only melted but volatilized with strong ebullition."*

Clark, page 92, "The fusion of this metal owing to the great improvements here mentioned in the mode of using the gas blowpipe, is now become so easy that this metal melts faster than lead in a common fire. It is no longer necessary to make use of wire in exhibiting its fusion and combustion. The cuttings which are sold by the manufacturers of platinum utensils are placed in a cupel, either mounted on a stand or held in a pair of forceps. The mouth of the jet is bent downwards so as to admit of a perpendicular direction of the gaseous flame upon the metal in the cupel. The flame is then suffered to act upon the platinum, about a quarter of an ounce of the metal being placed in the cupel at first, as soon as this begins to melt more may be added until a cupel of the common size is nearly full of the boiling metal; and in this manner a mass of platinum weighing half an ounce at the least, may be obtained in one brilliant bullet. This when rolled out so that all air

* The fusion and combustion and complete dissipation of platinum, gold, silver, nickel, cobalt, and most of the metals, and the fusion of the principal earths and of their most refractory compounds, by the use of Professor Hare's compound blowpipe, have been *the familiar and easy class experiments* of every course of chemistry in Yale College for these eight years.—[Ed.]

holes being removed the mass possesses a uniform density will be found to have a specific gravity equal to 20,857. During the fusion of the metal its combustion will be often if not alway apparent. It will burn with scintillation and particles of the black protoxide of platinun, if care be used, may be caught upon a sheet of white paper while the combustion is going on."

He would here evidently wish the reader to adopt the false impression that the facility with which platinum may be fused is owing to "the great improvements" made fourteen or fifteen years after I had devised and used them. Will Britons tolerate such conduct in their professors?

Silliman, last page. The experiments which have now been related in connexion with the original ones of Mr. Hare sufficiently show that science is not a little indebted to that gentleman for his ingenious and beautiful invention. It was certainly a happy thought and the result of very philosophical views of combustion, to suppose that a highly combustible gaseous body by intimate mixture with oxygen gas must when kindled produce intense heat, and it is no doubt to this capability of perfectly intimate mixture between these two bodies and to their great capacity for heat, that the effects of the compound blowpipe are in a great measure to be ascribed.

Clark, Journal Royal Institution, page 122. "I consider this improvement of the blowpipe, one of the most valuable discoveries for the sciences of chemistry and mineralogy that have yet been made " and thus does he modestly claim to his modification the whole merit of the discovery, for it must be observed, he does not in saying improvement on the blowpipe," allude to the compound blowpipe contrived by me but to the ordinary blowpipe of the mechanic or mineralogist. Other instances might be adduced, but it is presumed that more than enough has been brought forward to shew, that if the merit of this invention is to be awarded according to the motto of "suum cuique" adopted by Dr. Clark, there would be little left for himself and his coadjutors.

I subjoin a few drawings of the compound blowpipe in its different forms, and of some varieties of apparatus which may be used for supplying it with hydrogen and oxygen gas.

Explanation of the Plate at the end of the Volume.

Fig. 1. Original compound blowpipe, consisting of two common brass blowpipes soldered at their points into two perforations in a frustum of silver or platina,* after receiving the blowpipes. These perforations converge till they form one, the open end of which is their common orifice.

Fig. 2. An enlarged representation of the frustum. It may be of brass, the orifice being protected by platina, as the touch-holes of guns are sometimes. The whole of the instrument being comprised in fig. 1st, injustice has evidently been done by those who have spoken of it as cumbrous or requiring simplification.†

Fig. 3. The compound blowpipe under another form. A. is a brass ball with two arms, furnished with coupling screws, for attaching the instrument to the tubes through which the gases are to be supplied. B. is the pipe which receives and emits them as mixed for ignition. It is screwed into a perforation in the ball at right angles to another perforation bored through the common axis of the ball and arms. This pipe is made of stout brass wire, drilled so as to admit a piece of hollow platina wire about three-fourths of an inch long, to be inserted at one end. The platina wire is rendered firm without solder, by passing the brass wire with the platina in it through a wire plate by the wire-drawing process. The bore of the platina wire may be reduced to any size less than at first, by successive drawings through holes gradually smaller. Hence, by having the bore in the first instance made larger than can be wanted in any case, it is easy to produce pipes with orifices of every desired diameter.

Fig. 4. Exhibits the form above mentioned on a smaller scale, attached to the supply tubes. The latter have cocks and conical screws, for fastening them into a table, and also coupling screws, for connecting the instrument with the pipes employed to convey the gases to it, from the air holders in which they may be kept.

* The appellation, compound blowpipe, was given to this instrument by Professor Silliman, as he uses two blowpipes meeting in a frustum.

† It has been said that Mr. Cloud simplified it ; this is of course a gross error. If he simplified any thing, it was that part of the apparatus in which the gases are confined.

For this purpose, almost any kind of gasometer or air holder will answer; or two boxes or kegs, into which the gaseous materials may be pumped by a condenser, as in the case of Mr. Brooks' apparatus, used by Clarke. Fig. 9. A. reservoir, C. bladder holding gas, B. condenser, D. blowpipe.

In default of a better mode, two smaller tubs or kegs, or air tight boxes inverted into larger ones, might be resorted to. Being filled with water, this fluid might be displaced by gas delivered from the vessels generating it, and the gas thus collected would be propelled by the pressure of the water through tubes connected with the compound blowpipe.

Professor Silliman uses chests sunk in his pneumatic cistern, and filled by bellows pumps,* as in my original apparatus. I now employ sometimes the shelves of my pneumatic cistern, which are made like inverted trays; so that bell glasses filled with gas may be emptied into them by the hand.

A more commodious apparatus is represented by fig. 6th. At A. is a cistern, divided by a partition into two apartments, in which there are two gasometers, not differing materially from those used for confining carburetted hydrogen for gas lights, excepting that one of them is so contrived as to act as a self-regulating reservoir of hydrogen generated within it. A tray of copper full of holes, is supported by a sliding band or screw on the pipe in the centre, so as that it may be fixed at any desired elevation. This tray being covered by a stratum of granulated zinc, diluted sulphuric acid is poured into the containing vessel till all the atmospheric air is expelled from the gasometer through the pipe situated in its axis and communicating with the blowpipe seen with its table annexed to the cistern. The cock of this pipe being then closed, the action of the acid solution on the zinc causes hydrogen to be rapidly liberated, which fills the gasometer; and if the latter be prevented from rising too high, depresses the acid below the metal so as to suspend its action, until the escape of the gas through the blowpipe being permitted, (by opening the cock) the acid rises again over the metal and the evolution of gas recom-

* Or more frequently by conveying the gases as they are evolved from the materials, through tubes immediately into the boxes.

mences. The elevation of the sides of the gasometers above the horizontal partition or diaphragm, constitutes an external cavity, in which water may be poured so as to load them sufficiently. A. B. C. D. cistern, E. F. partition dividing it, H. gasometer, or self-regulating reservoir of hydrogen, G. gasometer for oxygen, I. I. two pipes closed at top and inserted air tight into the gasometer, L. M. two smaller pipes in the axis of those last mentioned, open at top, passing water tight through the bottom of the cistern and communicating with the blowpipe n. o. m. m. extension of the pipe M. by means of which, oxygen may be introduced from the iron bottle f.* P. P. rods which pass through holes in a sort of gallows, so as to regulate the movements of the gasometers, and stop them by the bands and screws R. R. at any height desired ; Q. Q. cocks, for draining the pipes L. and M. of any moisture which may condense in them.

This method of affording a regulated production and store of hydrogen gas, is somewhat analogous to that of Gay Lussac ; but has this superiority ; that the pressure is more equable, need not be greater than useful, and may be lessened at pleasure, so as not to have the tendency to leakage through the cocks, or any pores in the apparatus uselessly increased. Hydrogen is peculiarly subtile, and will escape when other gases will not.

Fig. 6, and Fig. 7,† represent self-regulating reservoirs of hydrogen, more closely upon the principle of Gay Lussac. I had availed myself of this principle to regulate the production of fixed air from carbonat of lime before I heard of its adoption by that eminent chemist. A (Fig. 8 ? *Ed.)* a partition dividing the cask into two apartments, the lower the largest. B B a false bottom, full of holes, raised above an inch from the real bottom of the cask. C a copper or leaden pipe, inserted at its upper end into the partition, and extending downwards a little beyond the false bottom. B

* The iron bottles used in commerce to confine quicksilver answer admirably well. The narrow end of a gun barrel usually fits them, and if not large enough, a section may be made near the breech where the barrel thickens.

It may be luted into the bottle with clay or lime and white of egg, and a longer pipe is then easily luted to the breech, where it cannot be injured by the fire.

† Fig. 7 and 8 ?—*Editor.*

D, a conical brass screw plug, inserted into a hole in the cask, to be removed or reinserted, as may be convenient. E a plug of wood for closing the pipe B. F a cock for regulating the escape of gas. The plug D being removed, and zinc in pieces introduced by the hole so as to cover the false bottom, diluted acid is to be poured into the cask, till the lower apartment becomes full. The cock F being closed, the hydrogen produced by the chemical action soon expels so much of the acid from the lower compartment of the cask, as to depress it below the zinc, when the action stops, till the expenditure of the gas allows the acid again to reach the metal. The plug E is of use to prevent the acid from pressing on the gas below, when pressure is not wanted. Fig. 7 may be understood by its analogy with Fig 6, (Fig. 8 ? *Ed.*) being merely another mode of putting the same principle into operation. Casks of the form of Fig. 6, (Fig. 8 ? *Ed.*) may be used as oxygen gas holders. The lower apartment is to be filled with water, the cock closed, and the plugs E, D put into their places so as to be quite tight. The pipe G only is to be open, and through this, the end of a tube is to be introduced, proceeding from a vessel in which oxygen may be generated. The gas displaces the water, which, as it flows out is to be caught and poured into the upper apartment of the cask. When the lower apartment becomes full G is to be closed. It is then only necessary to remove the plug E, in order to allow the water to press upon the gas, and propel it, when requisite, through a tube to the blowpipe.

Fig. 11 represents a contrivance, by which any vessel, with but one orifice, as a bottle, a demijohn, or carboy, may be made to act as an air holder; so that a number may be filled with oxygen gas over a pneumatic cistern, may be laid by, and then used as wanted. The cylinder A is to be inserted in the place of the cork or stopple. This cylinder has two perforations nearly collateral, one not more than one quarter of the diameter of the other. The smaller one, B, communicates with a small tube, furnished with a cock and coupling screw, for attaching a longer tube, communicating with the compound blowpipe. The larger perforation at C opens into a wide cylinder of sheet metal.—Into this cylinder another vessel, with a long neck, is inverted, after being filled with water. This fluid will of course run into the bottle, until the gas within is so much condensed, as to resist the pressure of a column of it sufficiently high to reach the orifice of the inserted vessel.

When this takes place, no more will descend, until by opening the cock, a portion of gas escapes: but as long as it is escaping, a proportionable quantity of water will come down, so as to keep the gas under an equable pressure, and of course an even flow towards the blowpipe.

Fig. 10, represents Lavoisier's apparatus for the recomposition of water, which Dr. Clark so uncandidly insinuates as suggesting the contrivance of the hydro oxygen blowpipe. At a, is a tube, by which, to exhaust the vessel A of air. At b, is another tube for supplying oxygen. At cc, a third tube for supplying hydrogen, to be ignited by a spark from the knob of the bent wire below it.

Art. XIV.—*An Experimental Inquiry into the chemical properties and economical and medicinal virtues of the Humulus Lupulus, or Common Hop, by* Ansel W. Ives, *M. D. of New-York.*

The hop is a hardy perennial plant, which grows spontaneously in the northern parts of Europe and America.* It belongs to the class *Diœcia*, and order *Pentandria*, of Linnæus. The plant which bears the male flowers is not cultivated, and is called the *wild hop*.† The common domestic hop, which is the female plant, is now to be the subject of investigation. Its general character is too well and too universally known to need description. The hop‡ has been regarded from time immemorial as an indispensable ingredient in malt liquors. It was introduced and cultivated for that purpose in England about the year 1549, and has since been used so extensively in that country and in many others, as to have become an important article of com-

* That the Humulus is a native of America, has been confirmed by the observation of Micheaux, Nuttall, Eaton, Torrey, and others.

† A very accurate drawing and minute dissection of the male and female hop-plant, may be found in "Lamarch's Encyclopedia," part 22d, plate 815.

‡ Writers have generally used the term *hop-plant* to distinguish the whole vegetable, and the *hop* to designate that part of it used in brewing.

merce. It has long been known, also, to possess some virtue as a medicine, and a general description of its character and properties is recorded in most Pharmacopœias.

Not having seen any accurate analysis of this article, and considering it important that the physician should know in what part of the plant its medicinal virtue resides, I commenced some experiments with a view to ascertain this object. The facts which were developed in the progress of the investigation, were, to me, novel and unexpected; and the results to which they obviously led, altogether different from what I had anticipated. The *medicinal* character of the hop was, therefore, now regarded as a subject of minor importance; for however desirable might be the merit of introducing to general use, a new and eligible *form* of medicine, that consideration would excite, comparatively, but little solicitude, while there existed a hope of effecting an improvement in domestic economy, which would be materially interesting to a great portion of the civilized world.

A quantity of hops was procured, which had been kept for domestic purposes, in a small bag, for three years. When they were taken from the bag, there remained about two ounces of an impalpable yellow powder, which, by sifting, was rendered perfectly pure. This substance has probably been observed by most persons acquainted with the hop, and I suspect has generally been mistaken for *pollen*, but it is peculiar to the female plant, and is probably secreted by the nectaria. It seems to have been more correctly appreciated by those accustomed to the domestic use of hops, than by many others professing a more scientific knowledge of their culture, properties, and use. I have not been able to find any notice of this powder in books, and know not that it has been designated by any appropriate term. In the following inquiry, therefore, it will be called *Lupulin*.

Exp. 1.—One drachm of lupulin was boiled with two ounces of water, in a small retort, till a third part of the water had passed over into a receiver. The fluid that came over indicated slightly the peculiar aromatic flavour of the hop; it was perfectly transparent, very little discoloured, and exhibited no appearance of a volatile oil. The water remaining in the retort was aromatic and bitter. When filtered and evaporated, it yielded ten grains of a pale yellow extract, intensely bitter, and possessing in a high degree the peculiar aromatic taste of the hop.

Exp. 2.—Two ounces of the best merchantable hops were distilled in a retort, with six ounces of water, till half of the fluid had passed over into a receiver of water. The water in the receiver was slightly impregnated with the odour of the hop, but there was no appearances of volatile oil.

Exp. 3.—Two drachms of lupulin were boiled in a retort with three ounces of alcohol. The alcohol came over strongly impregnated with the aroma of the lupulin; but there was no visible indication of an essential oil. The remaining alcohol had assumed a brilliant yellow colour, and a pleasant but intensely bitter taste; when filtered and evaporated, it yielded one drachm of extract of the consistance of soft wax.*

Exp. 4.—A saturated decoction of the lupulin was prepared with pure water. It was opaque and of a pale yellow colour. By adding to a portion of it a solution of the sulphate of iron, the colour was changed to a deep purple, approaching to black; a solution of animal gelatine, threw down a copious ash-coloured precipitate, which left the supernatant liquor transparent and clear. This liquor was now decanted; by adding to it a solution of iron, it was changed to a pale blue; the acetate and subacetate of lead, caused a copious curdy yellow precipitate; the nitrate of silver, a greenish flocculent precipitate; muriate of tin, when first added, produced no change, but after standing a short time, a brown precipitate; a solution of sulphate of alumine caused no immediate change, but by boiling with the decoction, it separated a dense precipitate. Silicated potash, alcohol, and vegetable blue, induced no change.

Exp. 5.—Two drachms of lupulin in four ounces of water, were digested six hours in a sand bath. The infusion yielded by evaporation six grains of aromatic and bitter

* These experiments, with some variation, were frequently repeated, with the view to detect, if practicable, the volatile oil which is so frequently mentioned by authors as essential to the flavour of beer. The result was uniformly the same. The peculiar aroma of the hop was always obvious to the smell and taste, but I was never able to separate it in the form of an essential oil.

extract. Two ounces of proof spirit were added to the same lupulin, and subjected to a moderate heat twelve hours; when filtered and evaporated, there remained six grains of a resinous extract. The same lupulin was digested thirty minutes in boiling alcohol, from which was obtained by evaporation sixty-two grains of extract. The extract obtained by the second process was soluble in pure alcohol, and when water was added to the solution, it became turbid and milky.

Exp. 6.—The lupulin used in the last experiment, was boiled in strong caustic ammonia. When filtered and supersaturated with distilled vinegar, a copious precipitate ensued, which was insoluble in alcohol, and possessed the sensible properties of an impure wax. The three last experiments show pretty satisfactorily, that the most important proximate principles of the lupulin are resin, wax, tannin, gallic acid, a bitter principle, and an extractive matter. The following experiments were instituted for the purpose of ascertaining more accurately their respective proportions, as well as the aggregate amount of soluble matter in a given quantity of lupulin.

Exp. 7th.—Two drachms of lupulin were infused five hours in boiling water. To the filtrated infusion, were added at intervals, five grains of animal gelatin in solution; when it ceased to produce any precipitate, and the supernatant liquor became transparent and clear. The sediment, when dry, weighed ten grains. An ounce of alcohol was added to the filtered solution, but it caused no change; by evaporation, it yielded fifteen grains of a very bitter extract. The same lupulin was digested again in boiling water—animal gelatin added to the filtered solution, induced no precipitate; by evaporation, an additional quantity of six grains of the watery extract was obtained.

Exp. 8th.—The extract obtained in the last experiment, was put into pure alcohol, and frequently agitated. After twenty-four hours it was filtered; ten grains had been redissolved by the alcohol, and an insoluble mass, weighing eleven grains, was left upon the filter.

Exp. 9th.—The same lupulin which was used in the seventh experiment, was now digested in alcohol. The infusion was highly bitter, and of a fine yellow colour; it gave by evaporation twenty-four grains of resin. By digesting in a second portion of alcohol, twelve grains more of resin were obtained, less bitter, but otherwise like the last.

Exp. 10*th.*—The lupulin which was the subject of the last experiment, after having been thus boiled in water, and digested in alcohol, was put into a small retort, and boiled in two ounces of ether. While boiling, it was filtered into a vessel containing cold water, by which means twelve grains of wax were obtained.*

Exp. 11*th.*—Half an ounce of lupulin was boiled successively in water, alcohol and ether. On weighing the insoluble residuum, it was found that five eighths of the whole had been taken up by the solvents.

From the foregoing experiments, all of which were, with some variation, frequently repeated, I infer, that the lupulin contains a very subtle aroma, which is yielded to water and to alcohol, and which is rapidly dissipated by a high heat; that no essential oil can be detected by distillation in any portion of the hop; that the lupulin contains an extractive matter, which is soluble only in water; that it contains tannin, gallic acid, and a bitter principle, which are soluble in water, and in alcohol; that it contains resin, which is dissolved by alcohol and by ether, and wax, which is soluble only in alkalies and in boiling ether; that it contains neither mucilage, gum, nor gum-resin; that the aromatic and bitter properties of the lupulin are more readily and completely imbibed by alcohol than by water, and much sooner by both when they are hot than when they are cold; that about five-eighths of the whole substance is soluble in water, alcohol and ether, there being about three-eighths of it vegetable fibrous matter. These proximate principles exist in very nearly the following proportions:—In two drachms (or one hundred and twenty grains) of lupulin, there is,

* The usual method of separating wax from vegetables, by boiling them in caustic Ammonia, and then super-saturating the alkali with vinegar, or with diluted sulphuric acid, is tedious, and the results unsatisfactory. The following is a much more easy and beautiful process. After digesting the substance in boiling water and cold alkohol, let it be boiled in ether, and the solution strained, while boiling, into cold water. The wax, which is held in solution by boiling ether, is thrown down as soon as the ether is cooled by the water, and its specific gravity being greater than that of ether, and less than that of water, it forms a beautiful partition between them. If the ether be suffered to evaporate, the wax may be taken from the water entire.

Tannin,	5	gr.
Extractive matter,	10	"
Bitter principle,	11	"
Wax,	12	"
Resin,	36	"
A woody fibrous substance, or Lignin,	46	"

Exp. 12.—Two drachms of the leaves,* from which all the lupulin had been separated, were digested twelve hours in six ounces of boiling water. The infusion was bitter, and exceedingly unpleasant to the taste ; it possessed none of the aromatic flavour and peculiar bitter of the lupulin. When filtered and evaporated, it yielded five grains of nauseous extract. The same leaves were again digested in six ounces of proof spirit: after twelve hours, the infusion was filtrated, and, by evaporation, yielded five grains of extract, similar to the last. The same leaves were digested twenty-four hours in alcohol ; the infusions manifested none of the sensible properties of the hop ; it gave by evaporation four grains of extract. The taste of none of the extractive matter obtained from the leaves was sufficiently characteristic of the hop to designate that it was obtained from that article.†

From this, and other similar experiments, leading to the same results, I think it is conclusively proved, that the virtue of the hop resides exclusively in the lupulin ; that the leaves contain a nauseous extractive matter, which is imparted to water and to alcohol, and which, instead of adding to the bitter and aromatic flavor of the lupulin, partially neutralizes or destroys it.

The obvious inference from these results was, that the lupulin was the only part of the hop essential to economical purposes ; an inference so little anticipated, that it became an important subject of enquiry, whether that part of the plant was duly estimated by practical brewers—whether it had been regarded by authors as preferable to the leaves, and if so, what impediment or what consideration prevented its being separated from the chaff.

* It will be understood that by the *leaves* are meant the calices which form the flower, or that part of the hop commonly used in brewing.

† It is necessary to remark that great care was taken to procure the leaves for this experiment perfectly free from the lupulin, which is ordinarily attached to them in great abundance. This cannot be done by threshing them.

On making enquiry of a number of brewers in this city, it was ascertained that there was about one in three who considered this powder useful, in common with other parts of the plant. It was known to all that hops were used principally for their antiseptic powers, or to preserve the beer from acetous fermentation; but neither practical brewers, nor scientific writers on brewing, appear to have noticed this substance particularly. By some of the former, it is regarded as useless. When at one brewery I asked for some of the yellow powder that was found at the bottom of the hop bags; I was told that I could find but little there, as but a few days ago they had swept half a bushel of it from the store.

I was now resolved to ascertain, if possible, the proportion of lupulin in the merchantable hop, and also whether it could be completely and readily separated from the leaves. Accordingly, six pounds of pressed hops were taken from the centre of a bag, containing some hundred pounds, and exposed to heat till perfectly dry. They were then put into a light bag and by threshing, rubbing and sifting, fourteen ounces of the pure powder was separated in a short time and with very little labour.

Though the quantity thus obtained was surprisingly great, there was obviously a considerable proportion remaining which could not easily be separated from the chaff. If therefore the hops were gathered when the lupulin existed in the greatest abundance, and, instead of being pressed and packed, were exposed to the sun till perfectly dry, there is little doubt but six pounds would yield a pound of the powder in question.*

The foregoing experiments were not completed till late in the spring, when the best season for brewing was passed, but with the advice, and by the direction of Robert Barnes, Esq. (an experienced and scientific brewer, zealous for the improvement of his art) two barrels of beer were made in which nine ounces of the lupulin were substituted for five pounds (the ordinary quantity) of hops. The result confirmed the most sanguine expectation. Though the quanti-

* Nothing conjectural would here have been introduced, but with a view to show, as accurately as possible, the proportion of lupulin, that the requisite quantity may be known in case it should be substituted for the leaves of hops in brewing.

ty of lupulin was less than what (according to the foregoing statement) usually enters into the same quantity of wort, and though the weather during the month of June was unusually warm and therefore unfavourable to its preservation, still the beer, which is now five weeks old, is very fine. It is pleasantly aromatic and bitter, and in a perfect state of preservation.

To ascertain the preservative property of the lupulin by a more direct experiment, equal quantities of the beer were put into separate vials and exposed, unstopped to the sun. To the beer in one vial was added a scruple of lupulin. The beer to which none was added, became mouldy and sour in ten days, the other was unchanged at the expiration of fifteen days.

Having, as I conceive, demonstrated that the lupulin, alone, contains the bitter principle and the aromatic flavour of the hop, which are essential to the excellence and preservation of malt liquor, and having shown also the feasibility of separating it from the leaves to which it is attached ; I shall proceed to enumerate some of the most obvious benefits which would result from these facts, should they be found applicable to practical use.

1. It would diminish the expenses of transportation.—In this the saving would be enormous. The hops which are now brought to this city are cultivated in the eastern states, and in the western parts of this state, and the expense of transportation is from one to two cents a pound. This is on account of their bulk, rather than their weight. Were the lupulin separated from the leaves, it being but about the sixth part in weight, and not one twentieth in bulk, it might be compressed into casks, and thus transported with convenience and at a small expense. In short the difference would not be less than that of sending wheat to market before and after threshing. Might it not also, for the same reason, become a profitable article of export?

2. It would lessen the difficulty and expense of storage. Notwithstanding the present mode of pressing hops into bags (which is done not less to diminish their bulk than to preserve their virtue) their storage is, as it ever has been, an important item of expense, as well as a very great burden to the brewer.

3. One object in pressing the hop into bags is, to preserve it from the injury of the air; a long exposure to which, it is said partially destroys its virtue. Whatever may be the cause, it is well known that the value of hops is diminished by age. This could not result to the lupulin any more than to our imported teas, were it packed in casks which would secure it perfectly from the air.

4. The brewer would evade an enormous loss, which he now sustains in the wort absorbed by the hops. Dr. Shannon, who has perhaps devoted more time and talent to the subject of brewing than any other English author, has demonstrated by a series of experiments, that one barrel of wort is absorbed by every sixty pounds of hops in the ordinary process of brewing.* The quantity of beer manufactured annually in London is upwards of one million five hundred thousand barrels,† and the least quantity of hops used in making it is two and a half pounds to the barrel, or three millions seven hundred and fifty thousand pounds; now as a barrel of wort contains not less than three bushels of malt, it follows, that the quantity of malt thus annually lost by absorption, is one hundred and eighty seven thousand five hundred bushels—the price of which may be fairly estimated at as many dollars.

5. It will lessen the temptation to the fraudulent practice which now prevails, of adulterating beer with other vegetable bitters. Notwithstanding the prohibitions of parliament there is no article which is the subject of such varied and extensive fraud in England at the present day as that of beer. As a substitute for the hop,‡ the coculus indicus, quassia and wormwood have all in turn been used; but all of them are so far inferior, both in their flavour and in their antiseptic or preservative properties, that the use of all vegetables in the manufacturing of beer, excepting malt and hops, is by law forbidden. By the improvement which is now proposed, so great would be the diminution in the price of the hop, from its being made an article of easy and

* Vide, Dr. Shannon's Treatise on Brewing.

† Edinburgh Encyclopedia, Vol. 2.

‡ Accum's Treatise on the adulteration of food. Also, Edinburgh Review, No. 65.

cheap transportation, that there would be little inducement for using any other article in its stead.

6. The lupulin is exceedingly bitter but not unpleasant, whereas the nauseous extractive matter of the leaves, which by boiling, is imparted to the beer, is unpleasant to the taste, and, when highly concentrated is frequently ungrateful to the stomach. It is believed that few persons ever relished the peculiar bitter of the strong beer, until, by drinking it habitually their taste becomes vitiated as is the case in the use of opium and tobacco. Soon after hops were introduced into use in brewing in England, the citizens of London petitioned parliament to forbid their use in the kingdom, as they were a nuisance, "*and spoiled the taste of their drink.*" The leaves then are not only useless, but prejudicial to the flavour of beer.

On the virtues of this substance as a *medicine,* I shall at present be very brief, as it will probably be made a subject for future consideration. It has already been observed that the hop has long been regarded as a medicine of some value. In France it has been used as a tonic and prescribed in dyspepsia and scrofula. In this country it has been most valued for its narcotic powers, and used in cases when opium was inadmissible. The most common preparation is a saturated tincture of the leaves. To this there are two important objections. 1. To give enough of the tincture of the leaves to induce sleep, the quantity of alcohol is necessarily so great as sometimes to do injury to the patient. 2. When given in large doses, it frequently produces nausea and sometimes vomiting. The first of these objections requires no proof, the second is confirmed by my own observation and by the experiments of Dr. Bryorley in his inaugural dissertation on the hop. This last effect is probably owing to the extractive matter in the leaves, for I have never seen it produced by the lupulin. I have prescribed the powder in substance, the infusion, decoction, alcoholic tincture and the extract. As its aromatic and bitter properties are imparted to water, the infusion is an eligible preparation as a tonic and stomachic ; but if given with a desire to produce sleep, the tincture is the best preparation. As it has been demonstrated, both by positive and negative testimony that the narcotic principle exists in the *resin* only, the tincture should always be made with alcohol and not with proof spirit. It is more difficult and expensive to prepare the extract than the tincture, and the latter in most instances is the most eligible preparation.

Its virtues are aromatic, tonic and narcotic; and it is, I believe the only article in which these properties are combined. Our country abounds with vegetable bitters and tonics, many of which are more powerful than the hop, but there is perhaps none which can so properly be denominated a stomachic. That family of symptomatic diseases which are the consequence of exhausted excitability, or more directly of an enfeebled and deranged state of the stomach and bowels, are certainly much relieved by this medicine. It frequently induces sleep and quiets great nervous irritation, without causing costiveness or, impairing like opium the tone of the stomach, and thereby increasing the primary disease, As an anodyne it will be found inefficient compared with opium. The saturated alcoholic tincture, in doses of from forty to eighty drops, will induce sleep with as much certainty as opium in cases of long watching from nervous irritability; but the same cannot be said of its efficacy in relieving pain. This substance then, is not commended as a medicine which ought to supersede the use of others of acknowledged virtue, but as a useful auxiliary, which undoubtedly possesses properties in some respect peculiar to itself, and as the part of the hop altogether preferable to any other, or to the whole as it is ordinarily used in tincture.

Art. XV. *Account of new Eudiometers, &c. invented by* Robert Hare, M. D. *Professor of Chemistry, &c. in the Medical department of the University of Pennsylvania.*

Among the operations of chemistry, none probably are more difficult than those called Eudiometrical, in which aeriform substances are analyzed.

Elastic fluids are so liable to contract or expand with the slightest change of temperature or pressure, that it is requisite to have the surface of the portion under admeasurement exactly in the same level with that of the water or mercury employed to confine it, and the heat of the hand may render the result inaccurate. There is no simple mode of causing the surface of the gas in a measure glass to form a plane corresponding with the brim of the measure glass containing it. The transfer of small portions of gas without loss, especially from large bells into small tubes is very difficult. Hence there is trouble, delay and waste.

I shall proceed to describe some instruments which I have lately invented, and which appear to be free from the disadvantages above described. They are all essentially dependent on one principle for their superiority.*

A recurved glass tube is furnished with a sliding wire of iron or copper, graduated into two hundred parts. The process of making wire by drawing it through a hole, renders its circumferences of necessity every where equal and homologous. Consequently equal lengths will contain equal bulks.

The wire slides through a cork soaked in bees-wax and oil, and compressed by a screw, so that neither air nor water can pass by it.

The length of the longer leg is fifteen inches, that of the shorter one six inches. The bore of the tube is from $\frac{4}{10}$ to $\frac{5}{10}$ an inch in diameter, but converges towards the termination of the shorter leg to an orifice about large enough to admit a brass pin. Over this a screw is sometimes affixed, so as to close it when necessary.

The tube being filled with water or mercury, and the wire pushed into it as far as it can go, on drawing this out again any desired distance, an equivalent bulk of air must enter the capillary orifice if open. By forcing the rod back again into the tube, the air must be proportionably excluded. Thus the movements of the sliding wire are accompanied by a corresponding ingress or egress of air, and to know how many divisions of the former have been pushed into the tube, or withdrawn from it, is the same as to know how much air has been drawn in or expelled.

If, instead of allowing the orifice to be in the open air, it be introduced within a bell glass, holding gas over the pneumatic apparatus, on pulling out the wire, there will be a corresponding entrance of gas into the instrument; and it must be evident that if the point of the gas measures be

* See the plate at the end of the volume.

transferred to the interior of any other recipient, the gas which had entered, or any part of it, may be made to go into any such recipient by reversing the motion of the wire. As the hands are, during this operation, remote from the part of the tube which contains the aeriform matter, no expansion can arise from this source, and the operation is so much expedited, that there is much less chance of variation from any other cause. By taking care to have the surface of the gas in the bell glasses below that of the fluid in the cistern, the density of the former will be somewhat too great, but on bringing the orifice of the gas measurer on a level, with the surface of the fluid in the cistern, the gas, no longer subject to any extra pressure, will assume its proper volume, the excess being seen to escape in bubbles. Should the tube in lieu of water, be filled with any solution, calculated to absorb any gas, of which the proportion, in any mixture, is to be ascertained, and if the quantity of absorption which can take place while the wire is drawing out, is deemed unworthy of attention, we have only to introduce the shorter leg of the tube into the containing vessel, as above described, and draw out the wire to two hundred on its scale, then depressing the point below the surface of the fluid in the pneumatic cistern in the usual time with due agitation, all the gas which the fluid can take up, will disappear. The quantity will be represented by the number of divisions which remain without the tube, after pushing in the wire just so far, as to exclude the residual gas.

Should it be deemed an object to avoid the possibility of any absorption during the time occupied in the retraction of the sliding wire, or should it be desired to expose the gas to a larger quantity of the absorbing fluid, an additional vessel is used, which is of an oblate spheroidal form, with a large neck, ground to fit on the shorter leg of a gas measurer, and furnished at the opposite apex with a tube, of which the bore converges to a capillary opening, surmounted by a screw, as already described, on the point of the gas measurer simply. This vessel (in shape not unlike a turnip) is filled with the absorbing fluid, and the gas measurer being duly charged with gas as above described, inserted into it. By the action of the sliding wire, the gas is propelled into the spheroid, where, by agitation and time the absorption is completed. Meanwhile the orifice of the spheroid should be kept open, and under water, so as to permit the latter to take place of that portion of the gas which disappears.—Whatever remains unabsorbed, is expelled from the glass spheroid, as in the case of the tube when used alone; and the divisions on the rod remaining without, will shew how much the fluid has taken up.

When atmospheric air, or oxygen gas is to be analyzed by nitrous gas, the glass spheroid is filled with water, and inverted with its orifice closed over the well of the pneumatic cistern. It should be supported by a wire stand, so as to leave the neck unobstructed. Any number of measures of nitrous gas, and of oxygen gas, or atmospheric air, may then be drawn into the measurer, and expelled into the spheroid successively, and the absorption estimated as already explained. When the residuum is too great to be expelled by returning the whole of the rod into the tube, by depressing the orifice of the spheroid just under the surface of water, the wire may be again gently retracted, water taking its place; and the movement may thus be alternated, till the whole of the remaining gas is excluded.

In order to apply this principle to Volta's process of ascertaining by explosion the quantity of hydrogen or oxygen gas present, in a mixture, the gas measurer is made as much stronger, as eudiometers are usually, when intended to be so used. It is in like manner drilled so as to receive wires for passing the electric spark. The instrument being charged with the gases successively in any required proportion, closed by the screw, and an explosion accomplished; to fill any consequent vacuity, the orifice is to be opened just below the surface of water or mercury. The quantity destroyed by the combustion is then ascertained by the sliding wire.

This experiment is more accurately performed by means of mercury than water. From this fluid, concussion, or even the partial vacuum produced by the gaseous matter, may extricate air, and thus vitiate results. There ought always to be a considerable excess of gas not liable to be acted on. The activity of the inflammation is lessened, and the unconsumed air breaks the shock.

I have found the galvanic ignition produced by a small calorimotor preferable to the electric spark. Suppose a piece of iron wire to be filed down in the middle for about one half of an inch to about one third of the original diameter. The whole is cemented into the perforation drilled in the tube, so as that the smallest part may extend across the bore. The wire should then be cut off at about one third of an inch from the tube, so as to stand out from it on each side about that distance. If these protruding wires be severally placed in the forceps of a calorimotor and the plates subjected to an acid, the small part of the wire within the tube is vividly ignited, and any gas in contact with it must explode. The interior wire is best made of platina, and may in that case be screwed into two larger pieces of a baser metal ; or a baser metal may be fastened on it, by drawing through a wire plate, and the platina duly denuded by a file where it crosses the bore.

The calorimotor which I have used for this purpose, consists of eleven plates of copper, and a like number of zinc, placed alternately within one-fourth of an inch of each other ; those of the same kind of metal being all associated by means of a metallic stratum of tin cast over them. The two heterogeneous galvanic surfaces thus formed, have each soldered to them a wire in a vertical position, and slit, so as to present a fork or snake's mouth. The wires are just so far apart as to admit the gas measurer between them, so that the wires of the latter may easily be pressed into the snake mouths. It is better that the wires of the gas measurer should be flattened in such manner as to present a larger surface for contact. There must also be an oblong square box or hollow parallelopipedon of such a width as just to admit the calorimotor, and more than double its length and depth. The calorimotor is placed within this box, at one end of it, about an inch below the brim. Diluted acid is poured in so as to occupy the lower half of the vessel, until it nearly reaches the plates. A plunger, consisting of a water tight box, or solid block of wood, is then made to occupy the other side of the little cistern. The depression of this causes the rise of the acid among the plates in the calorimotor, and consequently the ignition of a wire forming a communication between the surfaces.

This apparatus may be constructed in the circular form, by so placing two concentric coils, or several concentric hollow cylinders of copper and zinc, alternately within the upper half of a glass jar as to admit of a plunger in the middle, which in this case may be of an apothecaries stopper round or bottle. The acid solution must occupy the lower half of the vessel, unless when the plunger raises it.

I am under the impression that there is no form in which a pair of galvanic surfaces can be made so powerful in proportion to their extent, as in that above mentioned. The zinc is every where opposed by two copper surfaces by having this metal only a small fraction in excess.

Explanation of the Plate.

(See the end of the volume.)

Fig. 1. Sliding rod eudiometer or gas measure, surmounted by its spheroidal recipient. r r, sliding rod graduated into twenty divisions, each subdivided into ten, so as to make two hundred parts. At m f, are male and female screws, (forming what mechanics call a stuffing box,) by means of which a cork soaked in beeswax and oil is compressed about the rod. At n, is the neck of the recipient, ground to fit the recurved tube which enters it. At S, is a screw, by which to close the capillary orifice of the recipient.

Fig. 2. Eudiometer upon the same principle, but made stouter, in order to resist the explosion of inflammable mixtures. W W, wire to be ignited.

Fig. 3. Displays a construction of the sliding rod, by which, when desirable, greater accuracy may be attained in the measurement of gas. A smaller rod or wire is made to slide within the larger. Whatever may be the ratio (in bulk) of the rods to each other, the lesser may be graduated to give thousanths, by ascertaining how far it must be moved to produce the effect of a movement of one division on the larger rod, and dividing the observed distance into ten parts.

Fig. 4. Represents an apparatus adapted to explode an inflammable mixture, as mentioned in the preceding article, and so contrived to be a substitute for the well known apparatus in which an electrophorus is employed to ignite hydrogen gas. Moisture in the air suspends the action of that apparatus, but does not interfere with the one here represented.

A A, a cistern divided by a water tight partition, which separates the air holder G, from a calorimotor situated under C, and a plunger P, contained in the other part of it. W W, wires severally soldered to the different galvanic surfaces, and forked or slit at their ends, so as to embrace the wire of an eudiometer for the explosion of inflammable mixtures, as mentioned in the preceding article. At f f, are forceps (severally soldered in the same way) for holding a wire to be ignited by the galvanic influence.

These wires and the plates with which they are connected may be seen at fig. 5, where there is an enlarged drawing of the calorimotor and its wires.

It is supposed to be situated below the edge of the cistern, which is supplied with diluted acid reaching within a little distance of the plates.

c, a cock soldered to a pipe communicating with the inside of the gasometer. h h. a gallows and guide wire, for regulating the rise of the gasometer.

The construction of this will be better comprehended from fig. 6, where t represents the tray for holding the zinc, by means of which hydrogen is to be evolved. The tray is supported on the pipe in the axis of the vessel by a sliding band and screw, so that it may be raised or depressed at pleasure. When this tray is covered with granulated zinc, and the lower vessel is filled with acid so as to cover it, hydrogen must be generated until it occupies so much of the air holder, as to depress the acid from off the zinc. Supposing the apparatus thus prepared, on depressing the plunger at P, fig. 4, the acid in the cistern A A, will be forced up among the galvanic surfaces, and cause the wire at f f to be ignited. Turning the cock while the wire is red hot the hydrogen will be emitted and inflamed.

Art. XVI. *Analysis of two Zinc Ores from the United States of America; by* M. P. Berthier, *Engineer in the royal Corps of Mines, (translated by the Editor from the Annales des Mines 3d Livraison Ann.* 1819.*)

These two minerals occur together and are very abundant. They compose the principal part of a very thick and extensive metalliferous bed contained in a grauwacke formation in New-Jersey. They occur principally in Franklin, Sparta, Stirling, Rutgers, in the county of Sussex: they are accompanied by white laminated carbonate of lime, quartz, a peculiar greenish yellow garnet, and some other substances. One of these minerals (the zinc ores) is orange red, the other is of a metallic black. We will examine them successively.

1. *The Manganesian Oxid of Zinc.*

It is to Bruce that we owe the knowledge of the red mineral.† In 1814, he published a description and analysis of it in the American Journal, (vol. 1, page 96:) he found it composed of

Oxid of zinc, - - - - - -	0.92
Oxid of manganese and iron, -	0.08

It was named from its composition manganesian oxid of zinc. I have subjected this ore to many trials, and have repeated the analysis in many forms; like Bruce, I have found only oxid of zinc and oxid of manganese, but in proportions a little different from his, as will appear below.

The manganesian oxid of zinc is of an orange red, approaching blood red. It is in amorphous grains irregularly disseminated in the mass of the mineral: the fracture is

* The importance of these two ores, and respect to the memory of the late Dr. Bruce, who first made these ores known, have induced me to give the memoir entire.—*Editor.*

† Mr. Maclure had already, in 1811, transmitted the New-Jersey mineral to M. Vauquelin, who extracted from it

Protoxid of iron, - - - - - - - -	0.45
Oxid of zinc, about - - - - - - -	0.50
And protoxid of manganese, - - -	0.05

but it appears that this analysis was the result of a simple trial made upon the mixed mineral.

brilliant, lamellar in one direction and slightly conchoidal in the other; the thin slivers are transparent; it is fragile, easily scratched by steel; easily pulverized; the powder is of a beautiful orange red. After long exposure to the air it becomes covered with a white pearly coating, which appears to be composed of the carbonates of zinc and manganese. Its specific gravity, according to Bruce, is 6.22.

With the common blowpipe it is infusible without addition; with borax it gives a yellowish translucent glass. Under the flame of the blowpipe fed by oxigen and hydrogen it is volatilized, diffusing at the same time a brilliant white light. It loses nothing by calcination; while it is hot it appears brown, but as it cools it gradually resumes its pristine colour.

It easily dissolves in the cold in the mineral acids, and even in the acetic acid. During the solution heat is evolved, but without effervescence, and the liquor remains colourless. Still, with the muriatic acid it produces a solution of a brownish red, which, without the disengagement of any gas, gradually loses its colour: it is probable that a little chlorine is really but very gradually disengaged.* The oxids of zinc and manganese appear to have a great disposition to unite, and their complete separation is very difficult. To accomplish this object, I have employed six processes, of which I proceed to announce the results.

1. I have repeated the process of Bruce, which consists in pouring into a nitric solution of the two oxids the oxalic acid, as long as there is any precipitate, and then in washing and calcining the residuum. Bruce regarded the calcined precipitate as pure oxid of zinc; but I have remarked, that it always retains a very notable quantity of manganese, and that this is the reason why it always retains a foul yellow colour, more or less deep—a fact which Bruce observed without searching for the cause. The oxid of manganese is almost perfectly pure, and contains only that portion of iron, which, when the solution has not been made with the greatest caution, is accidentally present. Bruce, then, was able to obtain by this process, only an inferior quantity of manganese, to what really exists in the manganesian oxid of zinc.

* We are not told whether the *odour* of chlorine is perceptible.—*Editor.*

2. I precipitated the two oxids from their solution, by means of an alkaline sub-carbonate, having taken the precaution to boil the liquor, that it might not retain any portion: I calcined the precipitate with the contact of air, till the manganese was oxidized to a maximum, and afterwards, in one trial, I treated it with nitric, and in another with acetic acid—I evaporated it gently to dryness, and treated it again with water. Oxid of manganese remained perfectly pure, but the solution which contained the zinc, retained also a notable quantity of manganese; and when this solution was precipitated by an alkaline carbonat, the calcined precipitate was of a dirty yellow, more or less deep. By treating this precipitate anew, by means of acetic acid, a little oxid of manganese is separated, but much the greater part always remains with the oxid of zinc.

3. I precipitated the two oxids by caustic potash in excess, and allowed it to digest for some time—it was then filtered. The liquor contained nothing but oxid of zinc; but the residuum contained still a large quantity of this oxid, and it was necessary to redissolve, to precipitate anew by potash, and to repeat this operation many times, in order to complete the separation.

4. I precipitated the solution of the mineral by an alkaline carbonate, and through this solution diluted with water, I passed a stream of chlorine in excess—I obtained a violet coloured liquor and a black residuum. The liquor being evaporated in the air, became colourless, and deposited pure oxid of manganese. The black residuum having been treated by acetic acid, now contained nothing but oxid of manganese. The two liquors containing the zinc, were precipitated by a sub-carbonat. The calcined precipitate had a light yellow colour, and it was found to contain about $\frac{1}{200}$ part of its weight of oxid of manganese. It is probable, that by washing very carefully with abundance of water, the precipitate of zinc and manganese, and by agitating it for a long time with chlorine, no particle of the carbonate of manganese would escape the action of this agent, and that the two metals would be perfectly separated.

5. M. Berzelius has had the kindness to communicate to me the following method which has perfectly succeeded. I precipitated by an alkaline carbonate, washed the precipitate by decantation, digested it for sometime while still

moist, in ammonia; it became immediately brown, and the filtred liquor gave by ebullition a white deposit, which, by calcination, became perfectly white; it was the pure oxid of zinc: but I remarked that the deposit that was insoluble in ammonia, almost invariably contained oxid of zinc, sometimes in considerable quantity. To remove it entirely we may redissolve and reiterate the same operation; but it is better to calcine it, and to heat it with the acetic acid, which removes from it the greater part of the manganese, and to submit to the action of the ammonia only the deposit formed in the acetous fluid, by means of the alkaline carbonate. In this manner we separate the two oxids perfectly, and with the greatest precision.

6. Indeed, I have thought, that the zinc being very volatile, and its oxid easily reducible, we may readily separate it, in the dry way, from the oxid of manganese. This was practically verified. The oxids were mixed with a determinate weight of powdered charcoal, and the mixture placed *dans un têt étroit*, slightly hollowed, which was covered by a larger head, perforated in the upper part with little holes, a white heat was applied and a very abundant white vapour was disengaged.

As soon as it was certain that this disengagement had ceased, the head was uncovered, and the matter which it contained was roasted in order to burn out the remaining charcoal; the residuum, which was brown, was weighed, and to obtain the exact proportion of the manganese, the weight of the ashes which the charcoal would leave was subtracted, a weight which had been previously determined by experiment. The oxide of manganese proved on examination not to contain the smallest quantity of zinc.

All these trials almost exactly agree in giving for the result of the analysis of the manganesian oxid of zinc:

Oxid of zinc, - - - -	0,88
Red oxid of manganese, -	0,12
	1,00

It is difficult to say in what degree of oxidizement the manganese exists in this mineral. Its colour, and the appearances which it presents with the muriatic acid, render it probable that it is, at least, in the state of deutoxid. In order to be certain that the union so difficult to be overcome, between the oxid of zinc and the oxid of manganese, did not depend upon the intervention of any undiscovered substances, I dissolved pure oxid of zinc with the tenth part of its weight of oxid of manganese, equally pure, and heated the solution by the process described under No. 2. I obtained, as in the case of the American mineral, an acetous solution, with which the alkaline carbonates formed a precipitate, that became, in consequence of calcination, of a dirty yellow, and contained manganese.

II. *The black zinciferous mineral, the Franklinite.*

This mineral is composed of the oxid of iron, the oxid of manganese and the oxid of zinc. The association of these three oxids has never been before observed, and there is every reason to suppose that it constitutes a true species; but although it shall be discovered hereafter that these oxids are merely mixed, which appears very improbable, this mixture will appear too remarkable not to be denoted always by a name. As the chemical nomenclature cannot in every instance furnish a name, I propose to give it that of the *Franklinite*, derived from Franklin, in order to remind us that it was found, for the first time, in a place to which the Americans have given the name of a great man, whose memory is venerated equally in Europe as in the new world by all the friends of science and humanity.

The appearance of this mineral is much like that of the fer oxidulè (magnetic iron.) It is of a metallic black, is magnetic but without magnetic polarity; it occurs in grains, or in amorphous masses which sometimes present crystalline faces, but they are small and of rare occurrence, and do not enable us to determine the geometrical forms to which they belong; the fracture is either uneven or conchoidal, or imperfectly lamellar; it is not very hard; the powder is of a deep red brown, which distinguishes it from the magnetic iron whose powder is black. The specific gravity is 4,87. It is scarcely affected by the muriatic acid in the cold; but, by means of this acid, we can separate the carbonate of lime and the manganesian oxid of zinc, with which it is almost always mixed, and thus we can obtain it perfectly pure. It dissolves very easily in hot muriatic acid, without effervescence but with a slight smell of chlorine. The analysis is effected by dissolving it in muriatic acid, precipitating the solution by an alkaline carbonat, treating the wet precipitate by acetic acid to excess, evaporating to dryness by a gentle heat and removing the acetats of zinc and manganese by water; the calcined residuum is found to be the pure tritoxid of iron. As to the zinc and manganese, they are separated by the processes pointed out above.

In a specimen from Franklin there were found:

Peroxid of iron, - - - -	0,66
Red oxid of manganese, -	0,16
Oxid of zinc, - - - - -	0,17
	99

As the Franklinite acts upon the magnetic needle, the iron cannot be in the state of per-oxid, but is probably oxidized in the second degree. It is evident that the manganese is at least, in the state of deutoxid, because the mineral has a brown powder, gives with muriatic acid the odour of chlorine, and its muriatic solution contains the iron entirely in the maximum state of oxidizement. It is obvious that during the solution the two oxids react upon one another, and that the oxid of iron passes to the maximum by taking away the oxigen from the oxid of manganese, which is, on the contrary, reduced to a minimum.

For the purpose of verifying the result of the humid analysis, I made the following trials:—10 gr. of the franklinite were heated in a crucible *brasqué* without addition at the temperature proper for the assay of iron. A metallic button was obtained, to which adhered a very light greenish scoria; the whole weighed 5 gr. 65; the button was of an iron grey, hard, but impressible by the file, and capable of assuming a beautiful polish; it flattened under the hammer, and was broken with difficulty; its fracture was grey and granular, the grains being crystalline; it was analysed, and found to be an alloy of iron and manganese, without a particle of zinc; the loss in the experiment then represents the oxid of zinc, and the oxigen combined in the mineral with the iron and manganese.

There were heated at the same temperature, in a crucible "*brasqué*,"

franklinite, - - - - -	10 gr.
silex, - - - - - - -	4
alumine, - - - - - -	1.50
lime, - - - - - - -	1.40
Total, - - - - - - - - - -	16.90
There was obtained a button, weighing	12.77
Loss, - - - - - - - - - - -	4.13

which was owing to the volatilized zinc, the oxigen of the iron, &c.

The fusion was perfect; the metallic button weighed g4. 6; it flattened under the hammer, and the fracture was granular, and of various shades. The scoria was compact, vitreous, transparent and green; it weighed 8.17

Substract from it - - - - - - -	6.90
There remains - - - - - - - -	1.27

which represents the oxid of manganese that it contains. The g4. 6 of the "*fonte*" correspond almost exactly with the 0.66 of the peroxid of iron discovered by analysis; the metallic button ought to contain a little manganese, in the state of an alloy.

The alloy obtained in the first trial, ought then to be composed nearly of

Iron, - - - -	4.60	at most, - - -	0.814
Manganese, - -	1.05	at least, - - -	0.186
	5.65		1.000

Lastly, on melting in a crucible "*brasqué*" a mixture of peroxid of iron, red oxid of manganese, and oxid of zinc in the same proportions as in the franklinite, a button was obtained, precisely similar to that of the first trial. It is obvious then that the analysis of the franklinite can be performed both in the dry and humid way. The results by the dry way favour the opinion that in the analysis in the humid way, there is a loss of some portion of the zinc.

The minerals of New-Jersey may be advantageously turned to account in various ways. By assorting into one collection, the pieces in which the red mineral prevails, and into another those in which the franklinite is the prevailing part—the first can be employed as ores of zinc, to afford that metal by distillation, with charcoal, or to afford brass by fusion with copper and charcoal. If we stop at the extraction of the zinc, the residuum can be advantageously melted in the high furnace to obtain the "*fonte*," or at least it can be mixed for the same purpose, with the ores that are rich in franklinite.

As these minerals contain a considerable quantity of manganese, and their principal gangue is carbonat of lime and garnet, it is probable that they can be treated in the high furnace, without addition, and that they will prove very fusible. A "*fonte*" of excellent quality may be obtained from them, and in all probability eminently adapted for the production of the natural steel, like that which comes from the ores of spathic iron. There would be deposited in the chimnies of the high furnaces, a considerable quantity of the oxid of zinc, as is the fact in Belgium, where this substance is known under the name of *cadmie des fourneaux ou Keiss;* it is the richest and best material which can be used for the preparation of zinc and brass. It is possible that the abundance of the Keiss may somewhat impede the operation of the high furnaces, and necessitate the adoption of some particular arrangements, to extract it with facility; but the value of this substance would pay for the trouble it might occasion.

Finally, with the pure franklinite, which it will be very practicable to obtain, either by picking or washing, the trial can be made of preparing in the large way, the same alloy of iron and manganese, which I have obtained in the small way, and it can be seen whether it will not be better adapted than the common "*fonte*," for various uses.

Art. XVII. *A new process for Nitrous Ether, by Professor* Robert Hare, M. D.

The making of nitrous ether is a critical process. The action of the materials will often spontaneously increase so as to produce explosion. It may be conducted with ease and safety by means of a three necked bottle represented by Fig. 7, (in the plate which exhibits the eudiometers.)

The two outermost necks are furnished with funnels, and the central one with a tube bent a little more than at right angles, and passing through ice to the bottom of a bottle surrounded by the same. The acid and alcohol ought to be very strong. Let a gill of the latter be poured into the bottle, and then add as much acid as will make it boil briskly. When the effervescence relaxes, add more acid until the addition of this produces no great effect. Then add more alcohol, and again more acid, till the bottle becomes about one third full. The ether will be rapidly formed and collected in the bottle into which the recurved tube leads. This tube is represented in the plate of about one third of the proper length. There should be a triangular wooden trough adapted to it for holding ice or snow.

It might be an improvement if another neck were added through which the residual liquor might be drawn out. With this addition, the distillation of ether might be conducted in a way analogous to that of the distillation of whiskey by the celebrated Scotch still.

Art. XVIII. *Description of a differential Thermometer, by* W. Howard, M. D. *Adjunct Professor of Anatomy in the University of Maryland.**

This instrument is in imitation of Mr. Leslie's differential thermometer, but is on a different principle. In his, the degree of heat is measured by the expansion of air, but in the present one by the increase of expansive force of the vapour of ether or spirit of wine *in vacuo*, which affords a test of great delicacy, and is easily constructed.

† A tube (A) being first made with a ball at each extremity, in one of which is left a small orifice, a portion of ether or spirit of wine is then introduced, and heat being applied, is brought to a state of active ebullition. At this moment the orifice is closed with a piece of wax, and finally hermetically sealed by the blowpipe. The tube may then be care-

* From the London Quarterly Journal of Science, Literature and the Arts.

† See the figure at the end of the volume.

fully bent in the form of a hook,* and the scale and foot being adapted, the instrument is finished. (B.)

This thermometer is intended to be used in the same cases as that of Mr. Leslie, but I conceive it to possess some advantages. It is more delicate. When a heated body, as the hand, is approached to one of the balls, the liquid sensibly ascends or descends, and as soon as this cause is removed, begins instantly to return to its former level. Whereas in the air thermometer, the impulsion to the liquid is not instantaneous, and it continues to move in the same direction a moment after the heating cause is removed.

If the two balls were freed entirely from air, the liquid would always remain at the same level in each branch of the tube, except a trifling difference caused by capillary attraction. This perfection cannot be obtained by the most skilful artist; there always remains behind, notwithstanding all care to prevent it, a small residuum of air, which is sufficient to make a difference in the height of the two columns. To obviate this inconvenience, before the scale is adapted, the liquid is all to be brought into one ball, and the instrument is then reversed and left for a considerable time in that position, that both balls may acquire an equal temperature, and the small portion of air may be equally diffused through them. It is then to be restored to its proper position, and the point at which the liquid finally settles, is to be marked as the commencement of the scale. The same operation is to be repeated whenever the instrument has been deranged by transportation or other causes.

If it were possible to employ constantly ether or spirit of wine of exactly the same degree of strength, it is plain from the laws investigated by Mr. Dalton, that the scale would be constantly uniform; but as this is not easily obtained it is arbitrary. I have hitherto used the division of the millimetre of France.†

Note.—This thermometer is made by Pixii Dumotiez, Rue du jardinet, Paris, and by Mr. Newman, Lyle-street, London.

* The upper ball being slightly bent over to contain a small portion of liquid.

† The best mode of constructing the above instrument, is to bend the tube previous to the introduction of the ether, a considerable portion of which should be boiled out of the tube, in order to ensure the expulsion of

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Heat in the rays of the Moon.

Extract of a letter from Dr. Howard, dated August 29, 1820, *to the Editor of the American Journal of Science, &c.*

" All attempts, as far as I am aware, to discover any heating power in the lunar rays, by means of a common thermometer, have been unsuccessful. Indeed this instrument, however skilfully constructed, is not sufficiently delicate to be affected by the heat of the rays of the moon, which, if it bears any proportion to the light of the same rays, must be extremely small; as Dr. Smith concludes (Optics, Vol. I.) that the light of the full moon is to that of our day only as 1 to 90.000.

Having blackened the upper ball of my differential thermometer, I placed it in the focus of a thirteen inch reflecting mirror, which was opposed to the light of a bright full moon. The liquid began immediately to sink, and in half a minute was depressed 8°, where it became stationary. On placing a skreen between the mirror and the moon, it rose again to the first level, and was again depressed on removing this obstacle. I repeated this experiment several times to satisfy myself and some of my friends who happened to be present, that there was no fallacy in the conclusion of its being a positive proof of the calorific power of the lunar rays, and at the same time affording an evidence of the great delicacy of the instrument."

atmospheric air ; it is also convenient to tinge the ether of a red colour, by the addition of a drop of tincture of cochineal.

I have constructed upon the same principle a photometer, and an ethrioscope, both of which, though liable to some objections, are most curiously sensible to the impression of light, and to the frigorific emanations of the heavens. I have also employed a modification of the same instrument as photometric thermometer, which I have found useful in comparative experiments upon the light of different flames. For this purpose, the instrument is constructed as shewn in the engraving, by Dr. Howard ; the upper ball is then covered by a thin coating of Indian ink, and the other with gold leaf, applied by a dilute spirit-varnish ; it is then covered by a thin glass shade. Upon bringing a candle near the black, or sentient ball, that is within the distance of fourteen inches, or one foot, it produces an instantaneous depression of the column of liquid. Placing this instrument at the distance of sixteen inches from the flame of a wax candle, it fell 1° in 1′. A gas flame which I had previously ascertained, by a comparison of shadows, to give the light of eight wax candles, caused a depression of 10° in 1′, when placed at the same distance from the instrument. W. T. B.

Art. XIX. *Account of a new inflammable Air Lamp, by* Professor Jacob Green, *of Nassau Hall.*

TO PROFESSOR SILLIMAN.

Princeton, Feb. 11th, 1820.

Dear Sir,

The great facility with which hydrogen gas may be inflamed by even a moderate electric spark, suggested to Volta his inflammable air lamp. This, with a slight alteration, was patented, as a source of instantaneous light; and is usually found among the electrical apparatus of every person who has a taste for philosophical experiments.—One inconvenience attending the use of this ingenious contrivance, was, that the reservoir containing the hydrogen gas soon became expended, and could not, without some trouble, be replenished. Gay Lussac, however, not very long ago, removed this defect by suspending a bar of zinc in the apparatus, so as to produce by a sort of *self-action*, as much gas as was exhausted. There is another fault which has not been so happily removed; the electrophorus which is connected with this instrument, is, like all other *electrical machines*, so influenced in its action by the state of the weather, that there are some seasons when the smallest spark cannot be obtained. It has been my object in the little contrivance described in this communication, to point out a way in which *electrical fire* may be obtained, independent of the state of the atmosphere.

Description.

(See the plate at the end of the volume.)

A. B. C. D. is a square box, of mahogany, made perfectly air tight. At A. and C. small brass cocks are screwed into it, so as to form a communication with the inside. E. is a glass tube, open at both ends, passing through the top of the box, and extending within a short distance of the bottom. K. L. is a glass jar, with an open mouth P. such as is commonly used for collecting gases. R. S. is a piece of wood, two inches thick, with a groove turned in its top, in which the jar K. L. is fitted. There is also a hole, through which the tube E. passes, and terminates. F. is a small calorimoter, which is surrounded by the jar K. L. From the bottom of the calorimoter, proceed the two wires N. O. (which connect the poles of the instrument) through R. S. M. is a small blowpipe, with stop cocks, which communicates by means of a glass tube, with the interior of the jar K. L.; this tube must reach a little above the calorimoter, on the inside of the jar. G. is a glass vessel, placed in the jar above the calorimoter, the contents of which must be about one third more than that part of the jar which contains the calorimoter. H. is a vessel of like capacity with G. having an open mouth I, and a glass tube G. H. open at both ends, passing from the bottom, through P. and terminating at the bottom, within the glass vessels G. It is scarcely necessary to add, that all the joining of this instrument must be perfectly air tight.

To use the instrument.

Remove vessel H. and drop a few small pieces of zinc into G. through P.; then fill G. with a weak solution of sulphuric acid and water; pour it also into the box A. B. C. D.; through this stop cock A. till on a level with Y. Z.; then by blowing with the mouth into the box at A. the air above the fluid being compressed, will be forced up into the jar K. L. through this glass tube E.; and when the jar is completely full, turn the cock at A. and adjust the vessel H. in its place. Hydrogen gas will quickly be formed; the acidulous water in G. will be forced up into H; then by turning the cock A. the remaining water in K. L. will descend through E into the box below, and leave the jar filled with the gas; the fluid at the same time descending from H. into G. Now, if you wish to set fire to the hydrogen, place a small iron or platina wire from N. to O. blow up the acidulous fluid into the calorimoter by the stop cock A; the wire will be instantly heated, and by turning the stop cock of the blowpipe M. so that the gas may strike the heated wire, it will be inflamed, and a taper may be lighted. The action of the acidulous fluid on the zinc of the calorimoter, will furnish as much gas as will be consumed;

but, should there be an unusual consumption of gas, it may be supplied by suspending a bar of zinc in the vessel G. the lower end of which should reach only one third below the brim of the vessel; the reason for which will be obvious to those who understand the structure of the instrument. The stop cock at C. is for drawing off the acidulated water, when it becomes saturated with the zinc.

The calorimoter which I use differs a little in construction from those commonly made, and perhaps has some advantages. The following is a description of it: Take a sheet of copper, say four inches wide, and eighteen or twenty inches long; bend it in the form represented in Fig. 2. *(see the plate at the end of the volume,)* which is preserved in the required shape by a band of the same metal surrounding it; the intervals between each fold should be about an inch; then cast in proper moulds plates of zinc, of different sizes, so as to slide between these interstices, reaching from the bottom to the top, the edges of which should be grooved into little strips of wood, in order to prevent contact with the copper; all these plates of zinc should be connected together by a strip of copper along their upper edges. By this construction these plates can be easily removed, and cleaned whenever required. With an instrument of the above dimensions, I have melted off fine iron wire.

Art. XX. *Account of an improvement in the Electrical Lamp, by* Dr. James Cutbush, *of Philadelphia, in a letter to the Editor.*

TO PROFESSOR SILLIMAN.

Philadelphia, March 15, 1820.

Sir,

Some years ago, I purchased an inflammable air lamp, commonly called the Voltaic Lamp, made on the original construction, which I laid by, as not only troublesome to use, but very uncertain in its operation. A description of the apparatus with its appendages, may be seen in Adams'

Philosophy, vol. 2, page 93, American edition. Since the original was contrived by Mr. Volta, aided by Dr. Ingenhouz, several very important improvements have been made—more especially that arrangement by which gas is formed in the bottle extemporaneously, and of course without the use of an additional bottle and syphon, or the previous filling of bladders with hydrogen gas, a mode heretofore adopted both by Volta and Ingenhouz. In the apparatus which I procured, before it was altered I was obliged to fill the bottle with water, remove the stop cock and its connexion with the string from the electrophorus, and adapt a syphon coming from a bottle or flask containing dilute sulphuric acid and iron or zinc filings; and when filled with gas, to pour water into the upper vessel, in order to force it out when the cock was turned, which causes by its connexion with the plate of the electrophorus the transmission of the electric fluid, and of course its passage between the two conducting points. Filling the gas bottle in this way with gas, is at all times attended with trouble. Not possessing one of the improved kind, which obviates this inconvenience, I thought of having mine altered, which I had done, and found it to answer the purpose. The alteration consisted in removing a brass tube, which went from the lower to the upper vessel, and substituting in its place a glass one, which was attached and cemented to the upper vessel, so that when it was inserted in the bottle, and the upper screwed to the lower vessel, it would occupy such a distance as to be equivalent to the capacity of the water holder, a circumstance necessary to be attended to, in order to prevent the fluid when the gas is generated in the bottle from running over. It is obvious, therefore, that according to this improvement, all that is necessary is to fill the bottle with a mixture of sulphuric acid and water, in the proportion of about one of the former to eight of the latter, and throw in as occasion requires *through the tube*, when the upper is screwed to the lower vessel, either zinc or iron filings. The gas, as it is generated, will cause the fluid to rise in the tube into the upper vessel, which is always ready by its pressure, when the cock is turned, to force it through the aperture so as to come in contact with the spark. The bottle containing the diluted acid will last many months without being renewed, and when the saturation has been completed, and sulphate of iron or of zinc formed, as the case may be, the quantity of water will always prevent its crystallization. Hence it is a matter of some moment to have the acid sufficiently diluted.

In consequence of some defect or imperfection in the electrophorus cake, or of its splitting, which sometimes happens, I have found it necessary to remelt it, or to make a new one, by melting the best yellow rosin, and adding a small quantity of Spanish brown. Having melted the rosin, it was poured into a shallow dish made of tin plate, and left to cool undisturbed, not permitting however any bubbles to appear on its surface.

The electrophorus belonging to my apparatus, when excited will retain its effect for many months. I excited it in the usual manner, by gently warming it, and rubbing it with a foxtail, catskin, or silk handkerchief; the former of which I found preferable. When thus excited, I have been successful in producing a spark even in the dampest weather. It requires, however, that the box, which contains the electrophorus, should be kept as tight as possible.

There is one defect which in fact is inseparable from the construction of the cock; namely, that however perfectly tight it may be, by frequent use it becomes loose, and suffers the gas to escape gradually. To prevent this, and to make the cock as tight as possible, I have used various expedients, but the following I find preferable: mix a portion of tallow with finely pulverized plumbago, so as to render the whole as stiff as possible; then apply it to the cock.

From observation I have found, that hydrogen gas prepared by using zinc, makes its escape *more readily* than that prepared with iron filings; for, under the same circumstances, the former I have discovered to disappear sometimes in twenty-four hours, while the latter has remained more than a week. In consequence of this circumstance, I employ iron filings in preference to those of zinc, although we know that the gas from the latter is much purer and consequently lighter, whereas that procured by using iron filings contains more or less carbon, and is consequently impure.

The lamp answers every purpose, and I find it more certain for lighting a candle than any other contrivance, and therefore preferable to any which I have tried; having used at different times the *phosphoric match bottle*, the *pocket lights*, the *condensing syringe*, *flint and steel*, &c. I am aware, however, that the Voltaic lamp is not much used, and has been even laid aside, in consequence of the uncertainty of its operation. But from experience I can say, that since I have had the alteration made, I have seldom been disappointed in producing flame, and the apparatus is now always in order. The only thing to be attended to is, to throw in as occasion requires, some iron filings ; the quantity of which at a time will be readily known. One cubic inch of gas will light the taper at least ten times, if the cock is quickly turned. Therefore, from the quantity of gas, we may calculate the number of times we may light a candle.

ART. XXI. *Account of a gelatinous Meteor, by* RUFUS GRAVES, *Esq. formerly Lecturer on Chemistry at Dartmouth College, (communicated by* Professor DEWEY.)

ON the evening of the thirteenth day of August, 1819, between the hours of eight and nine o'clock, was seen in the atmosphere, at Amherst, Massachusetts, a falling meteor or fire ball, of the size, as represented by an intelligent spectator, of a man's hat, or a large blown bladder, of a brilliant white light resembling burnished silver.

The position of this spectator being in a direct line of the street where the luminous ball appeared, and at the distance of not more than five hundred yards, with the sight bounded by the buildings, there could be no deception relative to the direction that it took. Its altitude, at its first discovery, was two or three times the height of the houses ; it fell slowly in a perpendicular direction, emitting great light, till it appeared to strike the earth in front of the buildings, and was instantly extinguished, with a heavy explosion. At the same instant, as appeared from the report, and from the ringing of the church bell, an unusually white light was seen a few minutes afterwards, by two ladies in a chamber of Mr. Erastus Dewey. While they were sitting with two candles burning in the room, a bright luminous circular spot suddenly appeared on the side wall of the chamber near the upper floor in front of them, of the size of a two feet stand-table leaf This spectrum descended slowly with a tremulous motion nearly to the lower floor and disappeared.

In critically examining the chamber where the foregoing phenomenon was observed, it appeared that the light must have entered through the east front window in a diagonal direction, and impinged on the north wall of the chamber back of the ladies, and thence reflected to the south wall in front of them, forming the circular spectrum, with the corresponding tremulous motion of the meteor, and descending with it in the same direction, according to the fixed laws of incidence and reflection.

Early on the ensuing morning, was discovered in the door yard of the above mentioned Erastus Dewey, at about twenty feet from the front of the house, a substance unlike any thing before observed by any one who saw it. The situation in which it was found, being exactly in the direction in which the luminous body was first seen, and in the only position to have thrown its light into the chamber, (as before remarked,) leaves no reasonable doubt that the substance found was the residuum of the meteoric body.

This substance when first seen by the writer was entire, no part of it having been removed. It was in a circular form, resembling a sauce or sallad dish bottom upwards, about eight inches in diameter, and something more than one in thickness, of a bright buff colour, with a fine nap upon it similar to that on milled cloth, which seemed to defend it from the action of the air. On removing the villous coat, a buff coloured pulpy substance of the consistence of good soft soap, of an offensive, suffocating smell appeared; and on a near approach to it, or when immediately over it, the smell became almost insupportable, producing nausea and dizziness. A few minutes exposure to the atmosphere changed the buff into a livid colour resembling venous blood. It was observed to attract moisture very readily from the air. A half-pint tumbler was nearly half filled with the substance. It soon began to liquify and form a mucilaginous substance of the consistence, colour, and feeling of starch when prepared for domestic use. The tumbler was then set in a safe place, where it remained undisturbed for two or three days; and when examined afterwards, the substance was found to have all evaporated, except a small dark coloured residuum, adhering to the bottom and sides of the glass, which, when rubbed between the fingers, produced a fine ash-coloured powder without taste or smell; the whole of which might have been included in a lady's thimble.

The place where the substance was first found was examined, and nothing was to be seen but a thin membranous substance adhering to the ground similar to that found on the glass.

This singular substance was submitted to the action of acids. With the muriatic and nitric acids, both concentrated and diluted, no chemical action was observed, and the matter remained unchanged. With the concentrated sulphuric acid a violent effervescence ensued, a gaseous body was evolved, and nearly the whole substance dissolved. There being no chemical apparatus at hand, the evolving gas was not preserved, or its properties examined.

Art. XXII. *On the crystallization of Snow, by* Professor Jacob Green, *of Nassau Hall, Princeton.*

The crystallization of snow has for a long time excited the attention of the curious; few accurate observations however have been made upon it. Like the other phenomena of crystallization, this process is involved in much obscurity. Beccaria supposed that the regularity often noticed in these crystals was owing to electricity, and this will probably be found the true cause, not only in regard to snow but in every other instance of crystallization. We know that certain changes in the forms of substances are always connected with electrical effects, as for instance when vapour is formed or condensed, the bodies in contact with the vapours become electrical. Haüy has rendered it extremely probable that the integrant particles of matter always combine in the same body in the same manner, and that the combination is occasioned by cohesive attraction. May we not rationally suppose that what is called electrical polarity would induce them to cohere, not promiscuously, but in certain determinate forms. I need not here repeat the experiments which prove that the phenomena of electrical polarity are precisely analogous to those of magnetism, or that magnets will produce asteroidal figures with steel filings. With these hints I leave the theoretical part of the subject.

On the 16th of March, (1819) at 5 o'clock P. M. I had the pleasure of observing the beautiful asteroidal figures sometimes assumed by flakes of snow. On examination each appeared to be composed of six thin spiculæ, diverging like rays from a centre. There was but little or no wind, and Farenheit's thermometer stood at 33°. The figures which I observed are exhibited in the plate at the end of the volume, and the numbers annexed to them corrrespond with those in the following description.

No. 1. This is a simple hexagonal star, the radii were of equal lengths and the angles of convergence being equal, each angle was of course 60°.

No. 2. This crystal differs from No. 1, only in the length and breadth of the spiculæ, they were shorter and broader.

No. 3. A simple star, except that the radii proceed from a central knob.

No. 4. The same as the last, differing from it only in having the radii bifurcated at the end.

No. 5. Differing from No. 4 in having three prongs at the extremity of the radii.

No. 6. The radii pinnated near the centre, giving the appearance of regular hexagonal figures one within the other, about half the distance between the pinnœ and the extremity of each radius there was a knob.

No. 7. Pinnated as No. 6, but without the knob, and having each radius trifurcated at the end.

When the snow commenced falling, the above figures were more distinct and durable, but they could occasionally be discovered for about an hour amid the amorphous flocculi. Just as the crystals No. 6 and 7 began to melt, their pinnated radii were most brilliant, assuming somewhat the appearance of prismatic drops of dew. The figures were not all of the same dimensions; their principal difference was similar to that stated in Nos. 1 and 2. These figures were examined both with the single microscope and the naked eye; when not pinnated they were viewed with the most satisfaction without using a glass.

M. De Rattee, who has published an interesting article on this subject in the French Encyclopœdia, states, that regular crystals of snow do not often occur, but that the flakes are commonly of an irregular and unequal figure. He also remarks it is worthy of observation that the different sorts of crystals are scarcely ever seen during the same fall of snow, the varieties appearing at different hours of the day or on different days. I am of opinion they occur more frequently than is here supposed, and that different crystals are seen during the same fall of snow. We have besides the instance now noticed, the authority of Dr. John Netts, who has published a paper in the 49th Vol. (1756) of the Philosophical Transactions, entitled "*an account of a method of observing the wonderful configurations of the smallest shining particles of snow.*" In one day and night (he observes) I found fifteen, twenty or more particles of snow differently formed, such as Olaus Magnus mentions, and in the year 1740, on the 11th, 12th, 13th, 21st and 23d of January, and also on the 6th, 23d and 24th of February, I had an opportunity of delineating eighty different admirable figures of snow, and of observing their numberless varieties.

Accompanying this paper there are figures of ninety-one of these beautiful configurations; the size of them is much less than those observed by me on the 16th of March, and as they were examined with a double microscope, greater complexity was noticed. Most of Dr. Netts' figures are hexagonal, but some of the stars exhibited twelve radii.

In April 1817, Dr. P. S. Townsend read before the Lyceum of Natural History of New-York, a very interesting memoir on the crystallization of snow. In this paper the Doctor has collected most of the facts known respecting this subject, and has referred to the writers who have considered it. His communication was published in the American Monthly Magazine for May, 1818.

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Some time since an account of stellar snow was forwarded to us by Dr. Jacob Porter of Plainfield; it was described as being "in the most regular and beautiful crystals, each crystal consisting of six rays diverging from a common centre, and each ray of a number of inferior rays proceeding from it in a pinnate form." The forms observed by Dr. Porter will be found among those delineated by Professor Green.—[Ed.]

INTELLIGENCE AND MISCELLANIES.

Foreign Literature and Science.

(Communicated by Professor Griscom, of New-York.)

The number of books in all the public libraries of Germany, (including Austria and Prussia,) amounts at least to four millions, without reckoning memoirs, pamphlets, periodical publications, dissertations, and manuscripts.

Professor Goerg, of Leipsick, has proved, it is said, very satisfactorily, that the vinegar of wood (pyrolignous acid,) possesses all the antiseptic powers that have been ascribed to it. Anatomical preparations, and other animal substances, in which putrefaction had commenced, were completely restored by contact with this acid. An animal body in the opinion of this professor, may be readily converted into a mummy by this substance. The discovery of this acid is likely to become important to anatomy, domestic economy, and medicine.

In the empire of Austria, there are no less than twenty-three botanic gardens.

The unfolding of the manuscripts of Herculaneum, is carried on with very considerable success by a chemical process, under the direction of Sir H. Davy. Of one thousand six hundred and ninety-six pieces which have been found, eighty-eight have been happily unrolled, and the writing is very legible; three hundred and nineteen are not legible, and twenty-four have been given as presents to foreign princes. There remain one thousand two hundred and sixty-five, of which one hundred, or one hundred and twenty will, it is hoped, be saved from oblivion.

A plant, called *Chinininha* by the natives of Peru, has been analyzed at Madrid. It proves to be an excellent febrifuge.

The number of *new works* and *new* impressions offered for sale at the fair of Leipsic last year, by three hundred and thirty-six booksellers, amounted to three thousand one hundred and ninety-four.

Senifelden, the original inventor of the Lithographic art, (printing on stone,) has contrived a substitute for the carbonate of lime, used for that purpose, which has hitherto been found in perfection only in Bavaria. He forms an artificial plate, of stony substances, attached to paper, which he calls Papyrographic. It is said to possess great advantages. The machines are offered for sale at Paris, at from twenty to thirty dollars each.

A new method of taking the lives of animals destined for the market, which greatly diminishes their sufferings, is now employed in London. It is effected by means of azotic gas. The meat, it is said, retains its freshness better, has a more agreeable taste, and is more easily preserved. The greater number of the butchers are in the use of this method. *Rev. Ency. de Paris, Jan.* 1820.

An Academy of Natural Sciences has been formed at Cadiz, which holds its sittings in one of the halls of the medical and surgical college.

At the village of Chatiauneuf, in the department of the lower Alps, in France, a church was struck by three successive thunder bolts, on the 11th of July, 1819, about 11, A. M. during the installation of a new Rector. The company were nearly all thrown down, many of them were driven out of the door, eighty-two were wounded, and nine killed. The priest who was celebrating mass, was not affected, on account, it is believed, of his silken dress. All the dogs in the church were killed. The house was filled with black smoke.

Hot water is now carried through the streets of Paris for the purpose of supplying baths in private houses. It is transported in large casks, in which are stoves, so constructed, that the heat is spent almost entirely in raising the temperature of the water. It is forced from the casks through pipes, into the apartment required, and afforded at a very moderate price.

M. Gonord, of Paris, has discovered the art of enlarging or diminishing the scale or size of an engraving on copper, without changing the plate; in other words, if an engraved plate of copper be given to him, he can make use of it in such a manner as to obtain impressions of any size he pleases, either greater or less than those of the plate. From the plates of a folio atlas, for example, he can produce an atlas in octavo, and without changing the plates. He is able, also, by the methods he adopts, to make impressions upon various materials, as paper, metal, porcelain, marble, &c. *An. de Chimie, Jan.* 1820.

Steam Navigation is now making a rapid progress in Great Britain. There are on the river Clyde, twenty-five steam boats, the largest of which has a burden of ninety-one tons, and the least of thirty-five. Twelve of these boats pass between Glasgow and Greenock. There are four steam boats on the Frith of Forth, which are said to carry during the summer five hundred passengers daily.

Steam boats also ply on the Fay, the Humber, the Trent, the Thames, the Dee and the Mersey. Passengers are now conveyed by steam from Liverpool to Belfast and Glasgow, and from Dublin to Holyhead.

The Scotch are very locomotive. The number of passengers who were conveyed along the Forth and Clyde canal, between Glasgow and Edinburgh, amounted in 1818 to ninety-four thousand two hundred and fifty; between Glasgow and Paisley on the Ardrossan canal, fifty-one thousand seven hundred; and from Glasgow along the Monkland canal, eighteen thousand.

It is calculated that a person has fifteen hundred opportunities of leaving London in the course of twenty-four hours by stage coaches, including the repeated trips of the coaches which run short distances. It is understood that three hundred stage coaches pass through Hyde Park corner daily.

It appears by a note in the 16th number of the Journal of the Royal Institution of London, that the pyrolignous acid was known as early as 1661, and its property of converting minium into sugar of lead.

Homer's Iliad.—A copy of Homer's Iliad has been discovered in the Ambrosian library of Milan which appears to be of the fourth century, nearly six ages older than that on which the editions of Homer are founded. It contains sixty pictures equally ancient. They are on vellum. The characters of the manuscript are square capitals, according to the usage of the best ages, without distinction of words, without accents, or the aspirates; that is to say without any sign of the modern Greek orthography.

Heat of a Vacuum.—Gay Lussac has shown by experiment that when a delicate air thermometer is enclosed in a vacuum, and that vacuum is suddenly either enlarged or diminished no change whatever takes place in the thermometer. But if the smallest quantity of air be admitted, the compression, or more properly the diminution of the space occasions an elevation of temperature, and the enlargement occasions cold. This result he seems to consider as strengthening the hypothesis that caloric is not matter, or that it does not exist independent of matter.—An. de Chimie, Mar. 1820.

Education in Africa.—At the French settlements of St. Louis in Senegal, a school has been opened on the system of mutual instruction. It is attended by one hundred and fifty children. The kings of Galam and of Bambouk, more than two hundred leagues in the interior, have sent their children to this school. Lessons have been prepared both in the French and Yolof languages. Mr. Dard, the director of the school, has prepared a grammar and a dictionary of the Yolof (or Wolof.) He has also translated into that language the Old and New Testament. A school of fifty girls is also taught there by French nuns. Several African princes have visited the schools, and measures have been taken to establish others in the interior. The Senegal children possess great aptitude for instruction. They read, write and calculate with facility. Several of the monitors have become qualified to conduct other schools. The teacher

(Dard) appears to be a man of great mind. The establishment at St. Louis is under the direction of the Education Society in Paris.

A society is to be established in Edinburgh for the promotion of arts, similar to that in London, and connected with a repository of models on the plan of that at the Adelphi.

The king of Denmark has granted a pension of two hundred crowns during two years, to four persons distinguished for their knowledge, to encourage them to travel in foreign countries.

Dr. Perret, of Switzerland, has found that the roots of the Plantain, (Plantago major, minor, et latifolia,) is an excellent febrifuge.

Literature of the Low Countries.—During the first quarter of the present year there have appeared in the low countries (kingdom of Holland) three hundred and eighty-six new publications, of which eighty-eight are original; of these sixty are in Dutch, nine in French, four in Flemish, four in Latin, and eleven in other languages.

Bohea tea has been successfully cultivated in the department of Arriege in France.

Necrology.—Sir Charles Blagden, the celebrated English Philosopher, died at the house of Count Berthollet, Arceuil, near Paris, on the 26th of March last. He was eighty years of age, and retained to the last the sprightliness and vivacity of middle age. He spent much of his time in France, and was a diligent frequenter of the Institute, where he held an honourable seat. He was noted for pursuing the most exact plan in the distribution of his time, in his meals, his visits, &c. He kept a journal of passing events, in which were found the occurrences of the morning preceding his death. He kept up a regular correspondence with his friend, Sir Joseph Banks. He left a considerable fortune, and was very liberal towards the poor.

Volney, the French traveller and philosopher, died on the 22d of April last, aged sixty-three.

New Alkalies.—Two new vegetable Alkalies have been discovered by French Chemists, which they have named *Brucine* and *Delphine.* The first is found in what the discoverers (Pelletin and Coventon) call false Angustura bark, (Brucca Anti-dysenterica.) It crystallizes in oblique quadrangular prisms, colourless and transparent. It dissolves in five hundred parts of boiling water, and in eight hundred and fifty of cold water. Its taste is exceedingly acrid and bitter. Administered in doses of a few grains it is poisonous. It forms neutral salts and bisalts, which crystallize with facility.

Delphine was obtained by Lassaigne and Fenculle in the seeds of Staves Acre, (Delphinum Staphysagria.) It is crystalline when wet, but becomes opaque as it dries. Its taste is acrid and bitter. It melts by heat, and becomes hard and resinous. It is not very soluble in water. It forms neutral salts with the acids.

Count de Romanzow is fitting out at his own expense an expedition which is to pass over the ice from Asia to America, to the north of Behring's Straits; and to ascend one of the rivers which disembogue on the western coast, in Russian America, in order to penetrate into the unknown tracts that lie between Icy Cape and the river Mackenzie.

New Hydraulic Machine.—Mr. *Clymer* has invented in London a pump of a simple construction but powerful in its effects. It raises and discharges two hundred and fifty or three hundred gallons in a minute, not only of water but of stones and other hard substances which are not too heavy. It is of easy transportation, and appears particularly well adapted to ships, on account of its not being easily choked by sand, coffee, sugar, and other impediments.

An Egyptian Society has been formed in London for the purpose of publishing Lithographic prints of all the Egyptian monuments of architecture and sculpture as well as of mummies and hieroglyphic inscriptions, in order, if possible, by a comparison of signs, to discover their meaning.

Lithographic printing has made a rapid progress in Russia. The plates illustrative of the journey of Col. Drouville in Persia, are of the finest execution. The designs are from the hand of M. Orlowsky, a distinguished artist of Petersburg.

The Iron Masters of Sweden have granted to Professor *Berzelius* an annuity of five hundred crowns, for the services which he has rendered to the chemical arts.

The ex-king of Norway, Prince Christian Frederick, of Denmark, is leading a literary life in Italy. He lately read a dissertation on Mount Vesuvius at a meeting of the Academy of Sciences at Naples.

Count Lasterjoie is publishing at his Lithographic press in Paris, a series of plates to illustrate the machines, instruments, utensils, constructions, apparatus, &c. employed in rural and domestic economy, according to designs from various parts of Europe.

A vessel has been constructed for the navigation of the Forth and Clyde canal in Scotland entirely of forged iron, the sheets being pieced and riveted nearly as in a common boiler. It is *larger*, and at the same time *lighter*, and sails better than any of those employed. It will of course be more durable. It will contain two hundred passengers.—Rev. Enc. Mai 1820.*

The number of *letters* daily distributed by the Post-Office at Paris is nearly thirty-two thousand, and of Journals eighteen hundred. Whilst in London the amount of letters is one hundred and thirty-three thousand, and of Journals twenty-six thousand. This, according to the respective population of the two places, is, in Paris one letter for sixty-ty-two persons, and one Journal for three hundred and eighty readers; but in London, one letter for nine persons, and a Journal for forty-three readers.—Idem.

The literature of Italy is rapidly increasing. The "Bibliotheca Italiana," edited by *Acerbi*, the author of travels to the north Cape, announces that seven hundred cases of

* And a private letter from Glasgow to the Editor.

books of one hundred and fifty killogramms each, are annually imported into Milan from France, Switzerland and England; and without including the books which come from Germany, and especially from the Austrian states, and this commerce is principally in the way of exchange. The number of books published in Lombardy alone in the year 1819, amounted in value to more than one million and forty thousand dollars.—Idem.

B. Braconnot has succeeded in converting by means of sulphuric acid, various ligneous substances, such as saw dust, linen rags, hempen tow, &c. into gum and sugar. The gum perfectly resembles that of the *mimosa nilotica.* The sugar is much like that which is extracted from grapes. —Idem.

The Cashmeer goat has been introduced into the province of Rousillon in France with encouraging success. One hundred and twenty kids have been produced, and already bear the valuable down which characterises that species.—Idem.

Drawing in perspective has been introduced into some of the elementary (Lancasterian) schools of France. A work on this subject, adapted to mutual instruction, has been prepared by Francœur, professor in Paris.

The foundation of a new school for the fine arts has been laid in Paris, in the place where the museum of French monuments has been kept.

The canal of Alexandria in Egypt is prosecuted with vigour. Mines of lead and iron have been lately discovered in upper Egypt.

A steam boat has been constructed to run between Stockholm and St. Petersburg. The passage, which has heretofore been tedious and uncertain, can now be effected in sixty hours.

The population of Sweden has increased in three years, viz. 1816, 17 and 18, by seventy-two thousand three hundred and forty-six individuals. In the capital there has been a slight diminution, owing to the tendency of rich proprietors to engage more extensively in iron works and agricultural employments. The whole population in 1818, was two millions five hundred and forty-three thousand four hundred and twelve.

M. Kœnig, a painter of Bern, in Switzerland, has invented a method of producing transparent pictures so as to exhibit the effect of the sun, moon and fire in the greatest perfection. His landscapes of Switzerland are said to be much more perfect representations of the sublime scenery of the Alpine regions than any thing hitherto produced.

Oil has been extracted in Italy from the grape seed. It affords a light equal to that of nut oil: the smoke and odour are scarcely perceptible.

Preparations are making in Malta to introduce the system of mutual instruction on the coast of Africa, through the medium of the Arabic. A small book has been printed in that language explanatory of the system.

The Greeks of the Ionian Islands are about to witness the realization of their fondest hopes—the establishment of a University in Corfu. Lord Guilford has received from the English government the necessary instructions for carrying the project into execution. The Count Capo D'Istria, a native of Corfu, has contributed by various donations to the endowment of this University. He has furnished M. Politi, professor of chemistry in the new University, with the means of establishing a complete chemical laboratory.

A society of artists and men of letters in Paris, have engaged to publish a collection of lithographical portraits of celebrated men and women of that country, with a short biographical memoir of each person, and a fac simile of their writing as far as it can be obtained. Two numbers, containing each four portraits with their notices, &c. are published monthly at seven francs per number.—Idem.

The following method of producing pictures of metallic vegetation, by M. Goldsmith, has been read before the French Institute. Place a few grains of iron and copper filings on a glass plate at a certain distance from each other. Add to each parcel a few drops of nitrate of silver; the silver is soon precipitated in a metallic state, while the copper and the iron are oxidated and coloured. Then with a small stick arrange the ramifications of the silver, while the flame of a taper placed under the glass, promotes the evaporation of the fluid, facilitates the reaction of the materials, blackens the plate, and thus forms the ground of the picture.—An. de Chimie, Mai 1820.

Thenard has succeeded in causing pure water to absorb oxygen to the enormous extent of six hundred and fifty times its volume. The process is complicated. The principal agents he employs are barytes, and muriatic and sulphuric acid. The oxygenated water has a taste slightly astringent and bitter. It whitens the epidermis and occasions very pungent sensations. A great number of the metallic oxids act upon it with such energy as to produce explosions.
An. de Chimie.

[Notices communicated by a Correspondent.]

Boracic Acid.

About two pr. ct. of Boracic Acid has been obtained by evaporating the waters of the lakes in Cherchaio, and it has been proposed to deliver this acid in Paris, in any quantity, at three francs the kilogram. The acid is in small greyish scales, taste slightly bittter, aqueous solution reddens, litmus, &c. *Tilloch's Phil. Mag. Dec.* 1819.

" M. Lucas, in a letter to M. Arago, describes the occurrence of boracic acid in the water of Vulcano. It is found on the surface, at the parts most heated, and where vapors are continually rising. It occurs in a very white light state, though sometimes soiled, and sometimes mixed with sulphur. The crusts are generally about three quarters of an inch in thickness, and sometimes above a foot in extent. It occurs in scales, and sometimes fibrous. Their nature was ascertained by D. Gioacchino Azzorto, of Messina."

Brande's Journal, 16th No.

"*New method of preparing the Purple of Cassius.*—The Count de Maistre says, that placing a sequin in contact with mercury, at one of its surfaces, and twenty-four hours after fusing it with an equal weight of tin, an alloy was obtained, which was fusible in boiling resin. Afterwards triturating this alloy with pure caustic magnesia in a mortar, a powder was obtained of a very fine purple colour." *Ibid.*

"*Fulminating Gold.*—Count de Maistre also describes a fulminating gold, obtained by pouring a small quantity of solution of gold into red wine, (Bordeaux,) a sediment formed, which, when dried, and placed on burning charcoal, in an iron capsule, exploded." *Ibid.*

"*New Alkali.*—M.M. Pelletier, and Caventon, have discovered a new alkali in the seeds of the Veratium Sabadilla; it is crystallizable, and extremely acrimonious." *Ibid.*

"Mr. Donovan has published in the Annals of Philos. *a series of experiments on the compounds of mercury.* They relate to the chemical constitution of these compounds, and the proportion of their elements; but are concluded by an examination of the common mercurial ointment, and an account of a new one." From his experiments, Mr. D. "conceived that by forming a chemical union between fat and oxid of mercury, in very small quantity, the same results might be obtained; lard, and black oxid of mercury, were, therefore, kept at the temperature of about 350° for two hours, continually stirring them. At the end of the process, it appeared that every ounce of lard had dissolved, and united with twenty-one grains of oxid. This ointment was tried on many persons, and found to be as active as the common mercurial, containing twelve times the mercury. One drachm could be rubbed in completely in from six to ten or fifteen minutes, whilst common ointment required thirty or forty minutes, and rarely was any eruption produced on the part rubbed. The use of it is extremely cleanly, and its expense is very much below that of the common ointment. For the preparation of this ointment it is essential that the lard be entirely free from salt, or else calomel will be formed. The oxid may be prepared by decomposing calomel by pure potash, or by pouring solution of nitrate of mercury into caustic alkaline solution. The fat only dissolves three grains of oxid for each drachm, but the quantity in the ointment, may easily be increased. The oxid should be first triturated with a little cold lard, to make the penetration complete. The degree of heat is important. At 212° the oxid and lard will not combine, at 600° the oxid will be decomposed, and mercury volatilized, at 500° and 400° the oxid is partially decomposed, some red oxid being formed, and mercury reduced. The best heat is between 300° and 320°; it should be maintained at least an hour, and the ointment should be stirred till cold. This ointment is now undergoing extensive trial, and the results are very favourable. Already several testimonies have been given by medical men to its value." *Ibid.*

"*Lignite.*—Mr. Becquerel has examined and published an account of a stratum of fossil wood, occurring at Auteuil, in the neighbourhood of Paris, which seems of great extent. It contains, interspersed here and there, succinite, and crystals, supposed to be of mellite, but the exact nature of which has not been ascertained." "This stratum of lignite contains trees, still entire in their forms, some of considerable length, and varying in diameter from six to eighteen inches." *Ibid.*

Extract of a letter from Dr. Daubeny, of Oxford, (England,) to his friend in this country.*

"I spent three months," says he, "in Auvergne and the Vivarais, and am returned, quite convinced of the igneous origin of the whole of that interesting country. In some places, the streams of lava may be traced from their waters

* Dr. Daubeny is a promising mineralogist, and pupil of Jameson and Buckland—he has just returned from Auvergne, and the Vivarais, having previously studied the trap rocks of Scotland and Ireland.

in the most satisfactory manner, and every where, even in the most ancient volcanic rocks, there exist scoriæ, and other decided igneous products, which leave no doubt of the mode in which the whole must have been formed. Whether the trap rocks in this, (England, &c.) and other countries, are to be referred to the same cause, may still be doubted, but there are certainly many striking analogies between the products of the volcanoes of Auvergne, and the basalts of other countries. Indeed I would defy any mineralogist to distinguish the basalts of Auvergne from those of Ireland." Of Mr. Greenough's map, just published, he says, " it is the fruit of years of great labor, with the assistance of Professor Buckland, and other geologists, of the first eminence; its price is six guineas."

Of Dr. Mac Culloch's work, he says, " it contains a great mass of information; and the plates are splendid."

Dr. Boru, of Paris, who is a highly accomplished botanist, and geologist, is preparing a small work on the Geology of Scotland.

From No. 15 of *Brande's Journal.*

"*Death of M. F. de St. Fond.*—Science has lately lost M. Faujas de St. Fond, a distinguished mineralogist and geologist. He was born at Montelimart, in 1750, and died last July, (1819) at Soriel, near Valenci. He was Professor of Geology to the museum of Natural History, from the time of its establishment; he has enriched its collections by a vast number of curious objects, the results of his researches and travels, and France owes to him the discovery of one of its richest iron mines. M. Faujas has published many works on Mineralogy and Geology, as well as numerous memoirs in the Annales du Museum d'Histoire Naturelle. He has left a collection of minerals, shells, and alluvial fossils, among which are many extremely rare specimens, and of which the selection announces a Professor, who desired to rest upon facts to the utmost possible."

From Tilloch's *Ph. Mag.* for March.

" Preparing for publication, 'A Mineralogical Dictionary, comprising an alphabetical nomenclature of Mineral Synonymes, and a description of each substance—to which is prefixed an explanation of the terms used in describing external characters, and the crystalline structure and forms of minerals; illustrated by numerous plates, many relating to crystallography—the whole to be engraved by Mr. and Miss Lowry.

"*Geological Society of London.*"—From the report of the Council, February, 1820, it appears to flourish; the exertions of the members are great, and the numbers and collection increasing; the whole number of members, resident and foreign, four hundred and forty-two—income of the society, £946 11*d*. and the expenditure £798 16*s*. 10*d*. "The public spirit of the members has induced them to open a subscription, which already amounts to £600, as the basis of a fund applicable to the purchase of new cabinets, and of the most useful books and maps."

"The first part of the 5th Vol. of the Trans. has been published.

The geological map of Mr. Greenough is published; "the expense, it is supposed, will amount to £1700—and has been defrayed by the voluntary subscriptions of individuals, who have engaged to advance the entire sum required, upon condition of being repaid out of the first proceeds of the sale, while the loss will be theirs if the proceeds should fall short of the sum advanced, and the profits, if any, will belong to the society." New officers, 1820, of L. G. S.

The Right Hon. Earl of Compton, *President.*
Most Nob. Marquis of Landsdown, F. R. S.
Hon. W. T. H. F. Strangways,
Henry Thos. Colebrooke, Esq. F. R. S. &c.
John McCulloch, M. D. F. L. S. } *Vice-Presidents.*
Alexander Henderson, M. D.
Mr. Thos. Webster, } *Secretaries.*
Henry Heuland, Esq. *Foreign Secretary.*
Daniel Moore, Esq. F. R. S. &c.
Jno. Taylor, Esq. } *Treasurers.*

"Dr. Brewster maintains, from a number of experiments and their results, that amber is an indurated vegetable juice."

The No. for April, 1820, mentions,

"A new Geological map of England and Wales, with the inland navigation, &c. &c.: By Wm. Smith, Engineer, on one large sheet, neatly coloured and shaded—Cary, St. James-st. price 14*s*."

"Smith's Geological Atlas, No. 3, is published by Cary. This work exhibits on separate maps, the Geology of the several counties of England and Wales."

Conite.—Dr. Mac Culloch mentions in his account of the Western Islands of Scotland, a new mineral, discovered by him, and to which he applies the name Conite, from the powdery form in which it occurs—he has since found it in the Kilpatrick hills, in trap, and also in Sky—the same name has been applied by Prof. Schumacher to a very different substance; but Dr. M. thinks the latter is not likely to maintain its place in our catalogue of mineral species, but it is peculiarly appropriate to his new substance.

"*Emerald Mines.*—M. Caillaud's account of his discoveries in Egypt will shortly be published in Paris. Some time ago he discovered near Mount Zabarab, the famous Emerald mines, which were previously known only by the writings of the ancient authors, and the stories of the Arabs"—"they were discovered by M. C. nearly in the same state in which they had been left by the engineers of the Ptolomies. He penetrated into a vast number of excavations and subterraneous canals, some of which are so deep that four hundred men may work in them at once. In the mines were found cords, levers, tools of various kinds, vases and lamps; and the arrangement of the works afforded every facility for studying the ancient process of mining. M. C. himself set about working the mines, and he has presented six pounds of emeralds to Mahommed Ali Pashaw."—"On the banks of the Red Sea, the same traveller discovered a mountain of sulphur, on which some diggings had been made; in the neighbourhood of this mountain traces of volcanic eruptions were observable, and a quantity of puzzolana, and other igneous substances was found."—"He returned last year to Paris, bringing a vast number of drawings, &c. &c. which have been purchased by the French government. M. C. has again set out for Egypt."

Dr. John Murray.

[From Tilloch's Philosophical Magazine, July, 1820.]

"It gives us much regret to have to announce this month the death of that eminent chemist Dr. John Murray, of Edinburgh. He died at his house in Nicolson's street on Thursday, 22d July. The death of this distinguished philosopher, snatched from us in the prime of life, and full vigour of his faculties, will long be felt as a national loss. His works, now of standard celebrity at home and abroad, have, from the spirit of profound and accurate analysis, which they every where display, and from the force, clearness, and precision of their statements, most essentially contributed to advance chemistry to the high rank which it now holds among the liberal sciences. His very acute, vigourous, and comprehensive mind, has been most successfully exerted in arranging its numerous and daily multiplying details, defining its laws, and, above all, in attaching to it a spirit of philosophical investigation, which, while it lays the best foundation for extending its practical application, tends at the same time to exalt its character, and dignify its pursuit. As a lecturer on chemistry, it is impossible to praise too highly the superior talents of Dr. Murray: always perfectly master of his subject, and very successful in the performance of his experiments, which were selected with great judgment, his manner had a natural ease and animation, which showed evidently that his mind went along with every thing he uttered, and gave his lectures great freedom and spirit. But his peculiar excellence as a teacher was an uncommon faculty, arising from the great perspicuity and distinctness of his conceptions, of leading his hearers step by step through the whole process of the most complete investigation, with such admirable clearness, that they were induced to think that he was following out a natural order which could not be avoided, at the very time when he was exhibiting a specimen of the most refined and subtle analysis. With him the student did not merely accumulate facts, note down dry results, or stare at amusing experiments: he was led irresistibly to exercise his own mind, and trained to the habits of accurate induction. To those solid attainments which entitled Dr. Murray to stand in the first rank as a man of science, was united a refined taste and a liberal acquaintance with every subject of general interest in literature. His manners were easy, polite, and unpretending, regulated by a delicate sense of propriety, with much of that simplicity which so often accompanies strength of character and originality of mind. He rose to eminence by the intrinsic force of his talents; he was above all the second-hand arts by which so many labour to attract attention; and a native dignity of sentiment, and manly spirit of independence, kept him aloof from all those petty intrigues which are so often employed with success to bolster up inferior pretensions.—"

In common with all the pupils of Dr. Murray, I can feelingly bear testimony to the accuracy of the above delineation.—*Edit.*

Red Snow of Baffin's Bay.

"The nature of this substance was explained in Mr. Bauer's paper read before the Royal Society on the 11th May, as noticed in a former number. In the winter he put some of the red globules forming this substance into a phial with compressed snow, and placed the phial in the open air. A thaw having melted the snow, he poured off the water and added fresh snow. In two days the mass of fungi was found raised in little heaps, which gradually rose higher, filling the cells of the ice. Another thaw came on, and the fungi fell to the bottom, but of about twice their original bulk. They appeared capable of vegetating in water, but in this case the globules produced were not red, but green. The author found that excessive cold killed the original fungi; but their seeds still retained vitality, and if immersed in snow produced new fungi, generally of a red colour.—Snow, then, seems to be the proper soil of these fungi."

Breccia of Mont D'or.

"There are found rather abundantly in a ravine of Mont D'or, in Auvergne, fragments of a breccia, the hardness and other external characters of which, having led to the supposition of its being of a siliceous nature, mineralogists did not pay much attention to it, except on account of some particles of sulphur which it sometimes contains in small cavities. M. Cordier, having submitted this breccia to different trials, found that it yielded by heat a notable proportion of sulphuric acid; and upon this important indication, he proceeded to make a complete analysis of it, by which he found that this stone contained about twenty-eight per cent. of silica, twenty-seven of sulphuric acid, thirty-one of alumine, six of potash, and a little water and iron. These are very nearly the same ingredients as are found in the celebrated ore of Tolfa, which yields Roman alum. In reality, upon treating this breccia from Mont D'or in the same manner as is practised at Tolfa, that is to say, by breaking it, roasting it, and exposing it to a moist air, from ten to twenty per cent. of very pure alum was obtained from it; and this breccia even yielded alum without being roasted, but merely by exposure in a damp situation.

"It is probable, from the researches made upon the spot by M. Ramond, that, with some pains, the beds from which the fragments scattered in the ravines were detached, may be discovered; and that quarries may be opened, the working of which cannot but be of advantage.

"M. Cordier regards these sorts of stones as a mineralogical species consisting essentially of sulphuric acid, alumine, and potash. The silica found in it is not essential, for, quarries of a stone not containing any silica, but all the other constituent principles exist at Montrose, in Tuscany, and yield the same products as that at Tolfa. Those varieties of this species into which silica enters, are easily distinguished by the jelly they form when they are treated in succession with caustic potash and hydrochloric (muriatic) acid diluted with water.

"M. Cordier reduces to this species several volcanic stones, hitherto vaguely designated by geologists by the general denomination of altered lava."

[Foreign notices selected by the Editor.]

Poisons.

It is now ascertained that sugar taken in lumps is a certain antidote for verdigris : that vinegar counteracts the dangerous effects of alkaline substances; and that raw albumen (white of eggs) if administered in time, is a remedy for mercury sublimate.—Tilloch's Phil. Mag. Dec. 1819.

It may be added that vinegar counteracts the effects of narcotics and gluten those of corrosive sublimate.

New method of grafting Trees.*

A common method of grafting, is by making a transverse section in the bark of the stock, and a perpendicular slit below it; the bud is then pushed down to give it the position which it is to have. This method is not always successful; it is better to reverse it, by making the vertical slit above the transverse section, and pushing the bud upward into its position—a method which rarely fails of success: because as the sap descends by the bark as has been ascertained, and does not ascend, the bud thus placed above the transverse, receives abundance, but when placed below, the sap cannot reach it.—Annales de Chimie, quoted by Tilloch.

Phosphoric acid in Plants.

Free phosphoric acid is in all vegetable extracts and in a great variety of vegetables. Besides the acid in combination with lime, all cultivated plants appear to contain phosphoric salt in abundance. These facts were ascertained by Mr. Berry, by carrying on the evaporation *in vacuo*.—Tilloch. Jan. 1820.

Rectification of Alcohol.

A correspondent of the Giornale de Fisica, reports an experiment which may be applied with advantage to this purpose. It is a well known fact that water passes with facility through bladder, while alcohol is almost perfectly retained by it. If a bottle of wine be closed by a piece of bladder

* Perhaps the method described in this article corresponds rather with what is, in this country, called *inoculating*.—[Ed.]

instead of a cork, a portion of the water will be found to have evaporated and passed off through the membrane, and the wine left will be found proportionably stronger. If a bladder half filled with alcohol of the specific gravity of 867, and having its orifice closed, be exposed to the sun, the air, or the heat of a stove, in a short time the alcohol will be found rectified to 817 sp. gr. and in this manner all the water may be evaporated. If the same bladder with its contents, be then exposed to a humid atmosphere (as in a damp cellar) it will imbibe water, and return to 867 sp. gr. which water may be again separated by hanging it in a dry place. In one word, the bladder is a filter, which suffers water to pass through it but not alcohol.—Tilloch's Phil. Mag. Jan. 1820.

Hydrophobia.

It has been discovered by the inhabitants of Gadici in Italy, that near the ligament of the tongue of the man or animal bitten by a rabid animal, and becoming rabid, pustules of a whitish hue make their appearance, which open spontaneously about the 13th day after the bite; and at this time they say, the first symptoms of true hydrophobia make their appearance. Their method of cure consists in opening these pustules with a suitable instrument, and making the patient spit out the ichor and fluid which run from them, often washing the mouth with salt water. This operation should be performed the ninth day after the bite. The remedy is so effectual, that with these people this hitherto incurable disease has lost its terrors.—Bibl. Ital. quoted by Tilloch, Jan. 1820.

Thermometer.

Sanctorio invented the thermometer in 1590, but it was not reduced to a correct standard till 1724, by Fahrenheit of Amsterdam.

New geometrical work.

"An introduction to solid geometry, and to the study of crystallography, containing an investigation of some of the properties belonging to the platonic bodies independent of the sphere, by N. I. Larkin, M. G. S. teacher of crystallography and mathematics. Illustrated with four plates, from original drawings by the author, 8 vo. pp. 140."

"The work under consideration contains a description of a variety of solids hitherto unnoted, and a number of new and remarkable properties of those solids that have been long known. In tracing the properties of the platonic bodies, the author shows that they naturally divide themselves into two series, each consisting of five solids; and, what is remarkable, that each individual solid, in one of the series, is to be found in great abundance among crystals, whereas not a single individual in the other series has ever been found among such productions. The first he calls the natural, the other the artificial series. These two series bear a strong resemblance to each other; inasmuch as the last in each series contains all the foregoing in the same series: the angular points of the contained solids may be traced out in the surface of the last solid: and what perhaps is equally remarkable is, that the whole of the solids composing the natural series are commensurable with each other when the first four are contained in the last, and that they are to each other as the numbers 1, 3, 4, 6 and 8. There is another solid whose extremities may be traced out in the surface of the last of the natural series, which solid the author calls a cuboctahedron; this solid, though it is commensurable with the rest, is not simple, being as $5\frac{25}{27}$: consequently it is somewhat less than the fourth, being to it as 80 : 81. The author has combined the solids belonging to the natural series in pairs, in every possible manner, and given the ratios of their volumes in two tables; he has likewise given the ratios of a number of remarkable lines in or upon the solids, and has shown how each may be extracted from the others. The ratios between the members of the artificial series appear to be incommensurable, except in one instance, on which account they make a very striking contrast with the natural series, which are all commensurable. He afterwards describes five distinct dodecahedrons, which all admit of indefinite variation, and which, with the two before described, make seven; the whole of which are shewn to be singularly related with the cube. The descriptive part is followed by a series of demonstrations contained in fifty-three theorems, concluding with an appendix by Dr. Roget, containing a demonstration of the relations subsisting between the numbers of the artificial series, and likewise between their faces and their axes. The whole is illustrated by four plates, engraved in a superior manner by Mr. and Miss Lowry: the third plate is remarkably well executed, and is a flattering specimen of that young lady's abilities. Upon the whole, the work will be found of great service to prepare the mind for the study of crystallography, and at the same time highly interesting to the mathematician. Indeed, it is the only work in the English language in which the various properties of the geometrical solids are particularly described; on which account it cannot fail to be acceptable."

[A copy of this work has been presented to us by Professor Coxe, of Philadelphia; it is beautifully executed, and we were intending to publish an original notice of it till we met with the above in Tilloch's Philadelphia Magazine for January, 1820, to which we are happy in the opportunity of giving additional circulation.—Ed.]

Latent heat of Vapours.

According to the experiments of Dr. Ure, of Glasgow, the latent heat of

	°
Steam, is - - -	967.000
Alcohol, - - -	442.000
Sulphuric ether, - -	302.379
Naptha, - - -	177.870
Oil of turpentine, - -	177.870
Nitric acid, sp. gr. 1.494,	531.999
Ammonia, sp. gr. 0.978, -	837.280
Vinegar, sp. gr. 1.007, -	875.000

Boiling point of Liquids.

Water does not boil equally in a glass vessel; the temperature rises a degree or two above the regular boiling point, when a torrent of steam rushes up through it and the temperature sinks a little: this continues through the whole ebullition, and the temperature vibrates between two points, distant, two or three degrees from one another. This variation is more remarkable, and may be even dangerous, when sulphuric acid is distilled. If a few slips of platinum or of any other wire be put into the fluid, the water boils regularly as it does in a metallic vessel.—Annales de Chimie, &c. Vol. 8. p. 406.

Chlorine theory.

M. Vogel, of Munich, treated phosphoric acid and muriate of barytes separately, each in a platinum crucible, then they were heated together in a platinum tube, and abundance of muriatic acid gas was obtained : the same results were obtained with muriate of tin and muriate of manganese, and in a less degree with muriate of silver. Boracic acid also with the alkaline muriates gave similar results. These experiments are directly contrary to those of Davy and of Gay Lussac, and Thenard, and if correct, cannot be explained upon the new theory of chlorine.—Thomson's Annals, Historical Sketch for 1818.

Dr. Thomson's method of taking the sp. gr. of the gases.

This method is founded on the well known fact that when two gases are mixed their bulk does not alter. Provide a large flask with a stop cock ; weigh, exhaust, weigh again, the difference is the weight of the common air withdrawn. Let it be expressed by a. Then introduce the gas to be weighed, taking care first to exhaust the stop cocks connected with the apparatus, the volume of the gas which enters will be equal to that of the air withdrawn. Now weigh the flask ; the increase of weight above the weight of the exhausted flask is the weight of the gas introduced ; this may be expressed by b. The specific gravity of the gas is $=\frac{b}{a}$ without any correction for volume, as affected by heat or pressure.

If the gas is mixed with common air, determine the proportion, and then deduce the specific gravity of the pure gas by a very simple calculation. Let

x = specific gravity of the pure gas.
A = the volume of air in the mixture.
a = the sp. gr. of air.
B = volume of pure gas present.
c = sp. gr. of the mixed gas. Then

$$x = \frac{(A + B\ c - A\ a}{B}$$

Thomson's Annals, March, 1820.

Iode.

It appears from the experiments of Mr. Fife, of Edinburgh, and of M. Gaultier de Claubry, that Iode exists in sponges although in very small quantity: it is obtained both before and after incineration.—Annales de Chimie, &c. March, 1820.

Peaches growing on an Almond tree.

Mr. Thomas Richard Knight, long known by his great knowledge and success in horticultural pursuits, has obtained peaches from a sweet almond tree. The tree grew in a pot which contained about one square foot of earth, and was impregnated by the pollen of the peach. It produced nine peaches, the first fruit that it had borne; three opened in the manner of almonds and died, the other six had all the characters of the peach. Mr. Knight is of opinion that the peach and almond are originally the same species, and that an almond tree, may, by cultivation, become after a good many generations, a peach tree.—Annales de Chimie, &c. Mar. 1820.

A new Metal, (Aurum Millium.)

A letter from London to a gentleman in Baltimore, announces the discovery of a new metal by Mr. Mills. The writer describes the "aurum millium (as it is called) as resembling gold in colour; very durable, and malleable, and not expensive, the price being 4s. a 4s. 6d. pounce. It is hard and sonorous, has the invaluable property of not easily tarnishing, and is nearly as heavy as common jeweller's gold."

Systema Algarum.

Professor Agardh, of the University of Lund, in Sweden, announces that he is preparing for publication a Systema Algarum, that will comprehend the disposition and description of all the known species of cryptogamous water plants.—Dr. Torrey.

Astronomical Society of London.

Since the publication of the last number of this Journal, the following communication has been received. We cheerfully give it publicity, both from a disposition to promote the great object in view, and from sentiments of personal respect towards the individual whose signature is attached to the letter.

"London, March 10, 1820.

Professor Silliman,

Sir;

Having been requested by some friends to the Astronomical Society to send some of their plans and regulations to the public societies in America, and persons there who might be disposed to take an interest in this branch of knowledge, I with pleasure comply with their wishes in requesting your acceptance of the enclosed plan, hoping that its laudable object may meet with encouragement and communications. From the attention that has been paid to astronomy in America, and its great importance as an object of utility, I hope great benefits may arise from collecting and circulating knowledge in this branch of science, and that it may tend to facilitate our mutual intercourse, and promote the happiness and security of mankind.

I have the honour to subscribe myself,

Sir,

Your most obedient humble servant,

WM. VAUGHAN.

With the above letter, we received the address and constitution of the society, and a list of its officers and members. Among its members, we observe the names not only of some of the first astronomers and philosophers of Great Britain, but of some of her most eminent artists. This is very proper; for a Herschell, a Maskelyne, or a Newton, cannot advance a step in observing the phenomena of the heavens without the assistance of a Dollond, a Cary, or a Troughton; and the skill of these last can scarcely be acquired without producing in themselves serious advances in science as well as in manual dexterity.

The objects of the society are thus mentioned in their address—"the perfecting of our knowledge of the latitudes and longitudes of places in every region of the globe; the improvement of the lunar theory, and that of the figure of the earth, by occultations, appulses, and eclipses, simultaneously observed in different situations; the advancement of our knowledge of the laws of atmospherical refraction in different climates, by corresponding observations of the fixed stars; the means of determining more correctly the orbits of comets, by observations made in the most distant parts of the world; and in general the frequent opportunities afforded to a society holding an extensive correspondence of amassing materials, which (though separately of small importance) may by their union become not only interesting at the present time, but also valuable as subjects of reference in future." The society, in the conclusion of their address, sum up their views as follows: to encourage and promote their peculiar science by every means in their power, but especially by collecting, reducing and publishing useful observations and tables; by setting on foot a minute and systematic examination of the heavens; by encouraging a general spirit of enquiry in practical astronomy; by establishing communications with foreign observers; circulating notice of all remarkable phenomena about to happen and of discoveries as they arise; by comparing the merits of different artists eminent in the construction of astronomical instruments; by proposing prizes for the improvement of particular departments and bestowing medals or rewards on successful research in all; and finally by acting as far as possible, in concert with every institution, both in England and abroad, whose objects have any thing in common with their own; but avoiding all interference with the objects and interests of established scientific bodies.

Extract of a letter to the Editor, from a gentleman in Glasgow.

Our streets and shops are now lighted by gas, which is here, as every where else, found to be a most important improvement. New streets, almost without number, have been begun, and are advancing rapidly. In George's square, a bronze statue of Sir John Moore, by Flaxman, of London, has just been erected; and a proposal has been afloat for some time, to erect a monument, of some kind or other, to Sir William Wallace. Some suggestions have been made of one also to the memory of Watt, the improver of the steam engine, whose death you will have seen announced by the time this reaches you; he was a native of Glasgow.

I found on my arrival a Columbian Press at work. Clymer, the inventor, is in London, and has supplied a considerable number of them to the printers, who think the American are superior to any others, in ease of workmanship, and fineness of the work produced. Presses of every kind, however, will, in all probability, have to give way soon before a printing machine, which has been almost perfected in London, and performs about the work of six presses, with a man and a boy to put on and take off the sheets, and work the machine. It operates by a combination of cylinders, and can be driven by a steam engine, or any other moving power. It promises to effect a complete revolution in the art of printing.

DOMESTIC INTELLIGENCE.

Abstract of the proceedings of the Lyceum of Natural History, New-York.

1819. Mr. N. Paulding communicated a memoir on a mineral discovered at Kingsbridge, by Mr. I. Pierce, which had been supposed to be rubellite. Mr. Paulding having submitted it to a chemical and geometrical examination has proved that it is only a variety of schorl, which he calls *red tourmaline.* This mineral occurs imbedded in primitive limestone, or rather dolomite, in crystals, of various shades of red and brown, and is associated with reddish brown mica. The fundamental form appears to be an equilateral three-sided prism, acuminated by three planes, which at one extremity are set on the lateral edges, and at the other on the lateral planes. This form is variously modified by truncation and bevelments. Most of the crystals are bevelled on the lateral edges, forming nine-sided prisms. Sometimes the lateral planes are nearly destitute of striæ, though the faces of the acumination are always smooth and splendent. They vary from translucent to semi-transparent. Lustre vitreous, fracture imperfectly conchoidal, and fine grained, uneven. Fuses before the blowpipe. By friction the crystals exhibit positive electricity—heat did not excite any. Sp. gr. 3.05. Geometrical characters. Angle formed by the planes of the original prism 150°. Angle of the bevelling planes 120°. Angle formed by the planes of the original prism, and the acuminating planes 118° 30′. Angle formed by two of the acuminating planes 132°. These measurements agree almost precisely with the Tourmaline isogone of Haüy. Mr. P. is of opinion that the subspecies Rubellite is not sufficiently distinct from red tourmaline to deserve a distinct name, as its only essential character seems to be its infusibilty. The Rubellite of Chesterfield, however, is uniformly infusible, though it is frequently perfectly incrusted in crystals of common green tourmaline. The Geognostic situation of the red tourmaline of Kingsbridge, is somewhat uccommon. Schorl seldom occurs in limestone, though the limpid variety is said to occur in the limestone of St. Gothard.

Dr. Torrey demonstrated the anatomy of the *Scyllea pelagica* of Lin. and which has been so accurately described and figured by Cuvier in Anat. des Mollusques. There had been so much confusion respecting this animal in the works of all authors preceding Cuvier, that some zoologists have denied its existence. The principal cause of this was, that Seba, who first figured it, mistook the abdomen for the back. The specimens examined by Dr. T. were taken in the Gulf stream, on the Fucus natans.

Dr. Townsend read a continuation of his observations on some varieties of crystallized snow, observed near New-York. His former paper is published in the American Monthly Magazine.

Mr. Pierce read a memoir on the mineralogy and geology of the secondary region of New-Jersey, and presented many interesting minerals from localities not hitherto noticed ; among which were, beautiful specimens of *prehnite*, from Newark, second mountains, Scotch plains, &c. imbedded in greenstone. Some were almost of an emerald green. *Fibrous zeolite*, from Patterson, associated with greenstone. *White stilbite*, in compressed four-sided prisms, acuminated by four planes. These crystals were attached to prehnite, which was traversed by crystals of zeolite, from Scotch plains ; *fibrous malachite*, from Schuyler's mine, New-Jersey ; *compact peat*, from the vicinity of Elizabethtown.

Dr. Torrey read an analysis of the *fibrous sulphate of barytes*, lately found at Carlisle, Schoharie county, N. Y. The first public account of this mineral appeared in the Albany Gazette, Nov. 14, 1818, when it was announced as *celestine* or fibrous sulphate of strontian, though it had been known, and had circulation a year or two before. Dr. Torrey discovered the mistake soon after, though his analysis was not complete until February, 1819. This mineral so much resembles sulphate of strontian, that the mistake was natural. Its real nature however is very apparent when subjected to a few chemical experiments, especially when the sp. gravity is ascertained (4.320.) The fibrous sulphate of barytes analyzed by Klaproth (Analy. Essays, 2. p. 227) appears to be a very different variety from the mineral in question, and a very new variety should receive a name, we may retain that given to it by Mr. Eaton. The very remarkable character of the Carslile mineral is, that it does not decrepitate in the least before the blowpipe.

As an analysis of this mineral, which agrees very nearly with that of Dr. T. has been lately published by Professor McNeven, of New-York, it will hardly be necessary to make any further remarks on this subject. [For its geological situation, &c. see No. 5 of this Journal.—Ed.]

Mr. Pierce communicated a well characterized specimen of *kaolin*, which he found in considerable quantities near Weekawken, New-Jersey. This substance resulted from the decomposition of a secondary stratum, consisting of feldspar and quartz underlying greenstone. It was slightly fused by a blowpipe heat, in which it differs from the kaolin of France. This circumstance is probably owing to the potash of the feldspar not being entirely separated. It occurs in sufficient quantities to be used in the manufacture of porcelain.

Oct.—Dr. Torrey read an analysis of a mineral discovered at Patterson, N. J. by Mr. Pierce. This substance had been taken for prehnite, until the analysis of Dr. T. ascertained it to be the datholite, or silicious borate of lime. This rare mineral had heretofore been found only in Arendal in Norway, and its discovery in this country adds an interesting species to American mineralogy. Mr. Pierce has only observed it at a single locality, viz. near the Little Falls of the Passaic, where it was found in digging a well. The datholite occurs in pale green crystals, sometimes almost white, or in amygdaloid, the base of which is *wacke*, and is associated with stilbite, red and white analcime, prehnite and crystallized carbonate of lime. The crystals are aggregated, and vary in size from a small pea to an inch in length; of a complicated form and only partly emerged from the matrix, so that it is difficult to describe their precise shape. When heated before the blowpipe it melts with scarcely any intumesence into a colourless glass. Its powder strongly gelatinizes in acids. If some nitric or muriatic acid be boiled to dryness in powdered datholite, and a little alcohol added to the mass, it burns with a beautiful green flame. From Dr. T's analysis, the Patterson mineral contains much less boracic acid than the datholite of Norway, analyzed by Klaproth, and it may prove to be a new variety.

Nov. 15, Dr. Torrey read a memoir on the *Tuckahoe*, or Indian bread, a subterraneous fungus of the southern states. This substance was first described in Clayton's Flora Virginica, as the *lycoperdon tuber*, though it is a very different fungus; and it has hardly been noticed by any succeeding author. In May 1817, the late Dr. Macbride, of Charleston, communicated to the New-York Philosophical Society an account of this very singular production,* in which he maintained that it was a real fungus which was attached to the roots of living trees, and not as it had been contended,

* An abstract of this paper is published in the 1st Vol. of the Amer. Mon Mag.

the root of a convolvulus or any other plant. The *tuckahoe* occurs from one to three feet under the surface of the earth. Its form is for the most part globular, and it is found from the size of an acorn to the bigness of a man's head. Dr. T. has ascertained that the tuckahoe belongs to the genus sclerotium of *Tode* and *Person*, and that it is an undescribed species of that genus which he calls *S. giganteum*. Dr. Macbride supposed that the substance of the sclerotium consisted of gluten in a peculiar state. Dr. T. in an elaborate analysis of this fungus, has proved that no gluten enters into its composition, but that it consists almost entirely of a peculiar vegetable principle which he calls *sclerotin*. This substance is very soluble in even weak caustic alkalies, and the solution gelatinizes by acids and most neutral salts.

Dr. Torrey read an account of a new mineral from Schooley's mountain, New-Jersey. It somewhat resembles graphite, but is much heavier and possesses very different characters. According to Dr. T's analysis it consists of iron in a metallic state, and graphite, in the proportion of 54.25 of the former, and 11.50 of the latter. He proposes for it the name of *siderographite*.

1819.—Mr. I. P. Brace, a corresponding member of the Society, communicated a memoir on the geology and mineralogy of Litchfield in Connecticut, which he illustrated with a handsome *suite* of specimens. Litchfield is entirely primitive, and the basis rock of all the hills is *gneiss*, though *granite* is occasionally found alternating with it. The rocks lying on this are *porphyritic granite*, *mica slate*, *sienite*, *primitive greenstone*, *steatite* and *limestone*. Mount Prosper, near the west end of the town, is entirely composed of *porphyritic granite*. Mount Tom, south west of the town, appears to be composed of rocks of sienite heaped together on a base of this granite. Among the minerals sent by Mr. Brace, were large and beautiful crystals of *cyanite* associated with *talc* and *mica slate*, staurotide with garnets, in mica slate, chalcedony, *blue feldspar*, and *beryls* in large crystals in granite.

A memoir was read by the president, Dr. Mitchill, on an interesting species of fish, viz : Gobiomones *grandicauda*, Bodianus *triacanthus*, Esox *cirrhatus*, Diodon *verrucosus*, Squalus *squatina* and Saccopharynx *flaggellum.* All these are found in our waters, and form a valuable addition to our icthyological catalogue. Of these the S. *flagellum* is the most interesting. This species is six feet in length, the body and head being but fourteen inches. In the shape and structure of the body it differed so much from every fish hitherto known, that some doubt was at first entertained whether it actually did belong to that class. This however was fully established by the learned president. By means of a particular structure, not easily understood except from actual inspection, the animal is able to dilate his mouth to an astonishing extent; from this and the whip-like appearance of his tail, he has derived his generic and specific names. The body is round, cylindrical, scaleless; dorsal, anal and caudal fins united. Belongs to the order Cartilaginæ. A particular anatomical description of this interesting animal is much wanted.

Dr. Townsend read a memoir on the organic remains at Corlaer's Hook, in the environs of New-York. Part 1st. Milleporites, with drawings and specimens. These are found in a bank of alluvial sand, resting immediately on the primitive rock of the Island. Dr. T. described two species and four varieties of *ramose millepores.* Most of the specimens found belong to these species. The division ramose he found it necessary to establish, although it approaches the millepora truncata of Ellis. Of *reticulated millepores* he describes one species. The great abundance of these remains serves to refute the opinion of Parkinson, (Vol. 2. p. 71.) that there are few millepores in a fossil state. The substance of these specimens is alumino-silicious.

Mr. N. Paulding read a memoir upon marine fossil shells, found in great abundance in every part of Prince George's county, Virginia, and presented to the society by I. W. Philip, U. S. A. They belong to the genus pectunculus, turritelea, arca, murex and teredo of authors.

Many valuable donations have been received by the Lyceum, among which we have only time to enumerate the following :

A valuable collection of insects, consisting of five hundred and twenty-five specimens, chiefly of the orders colcoptua and lepidoplua, from Professor Zincken Sommer, physician to the court of Brunswick.

Specimens of minerals from Col. G. Gibbs, among which were native gold from Siberia, fluate of lime from New-Jersey, and granular corundum from Naxos.

Organic remains from Werberg, near the Weser in Germany, from Rev. F. Schaeffer.

Numerous minerals from Professor Geimar, of Hallé, with a catalogue.

Organic remains, consisting of vertebrae of fish and cetacea, bivalves and recent bones of some unknown animal, from Dr. William Swift.

Hortus cryptogamicus Edinensis No. 1, an herbarium of cryptogamic plants, growing near Edinburgh, (Scotland) presented by J. Stewart, lecturer on botany in that city

Specimens beautifully prepared of the *anas acuta*, or pintail duck, (Wilson) by the late Mr. Clements.

Organic remains from Corlaer's Hook, and a specimen supposed to be oolite, never before discovered in this country, by Mr. Cozzens.

Valuable collection of American minerals, among which radiated zeolite, from Westchester, &c. by W. R. Clapp, corresponding member.

[It is feared that, owing to the illegibility of the MS. some errors may have crept into the above " abstract."—Ed.]

American Geological Society.

The anniversary meeting was held in the cabinet of Yale College; and the officers of the last year were re-elected, with the exception of Mr. T. D. Porter, who, in consequence of removal to a distant state, resigned the office of Secretary, and Dr. Alfred S. Monson, of New-Haven, was elected in his stead.

The society directed that an appropriate address should be delivered by a member at the next anniversary. The case ordered to be constructed, to receive the commencing collection of the society, is finished, and in a good measure filled. A box of specimens has been presented by Colonel Gibbs; and another is announced as being on its way from Professor Dewey, of Williamstown.

A letter has recently been received by one of the Vice-Presidents, from William Maclure, Esq. President of the society, dated at Paris, in August, informing that a collection of books,* and two boxes of foreign specimens, collected by Mr. Maclure, during his travels in Europe, had been shipped for the society, and that another box of rock specimens had been ordered by him to be sent from Philadelphia. A box of specimens has been presented to the society by Professor Amos Eaton, and Dr. Theodore R. Beck; the collection was made during their late examination of Albany county, and is illustrative of the mineralogy and geology of that district.

Pharmaceutical preparations.

Dr. Thomas Huntington, of New-London, is engaged in manufacturing medicines, particularly such as are prone to be adulterated, or are particularly important. From the zeal manifested by this gentleman, and his skill, as evinced by some very neat, and apparently pure preparations, transmitted to us, we cannot doubt that he is entitled to the confidence of the medical faculty, and to that of the public.—Among his preparations we notice the precipitated carbonat of iron, the green sulphate of the same metal, and the sulphate of zinc, and the muriat of barytes. We understand that he will prepare the phosphat of iron, and that he will occupy himself particularly with the formation of extracts, such as that of cicuta, &c.

Sulphate of Barytes.

We have received from Dr. Comstock, of Hartford, some handsome specimens of sulphate of barytes, penetrated by

* Perceived from the catalogue to be very valuable.

green and blue carbonat of copper, in beautiful contrast with the white of the barytes.

The sulphate of barytes forms a vein of five or six inches thick, in greenstone trap, which reposes on an argillaceous sandstone, two miles from Hartford.

Carbonat of Barytes.

Professor Rafinesque, in a letter to Dr. Torrey, of New-York, announces the discovery of large quantities of the carbonat of barytes, near Lexington, in Kentucky. We shall wait with much interest for a confirmation of this very interesting observation.—[*Ed.*]

Comet of 1819.

We have just received a part of the IVth Vol. of the transactions of the American Academy of Arts and Sciences, now printing, which contains a memoir on the orbit of this comet, by Professor A. M. Fisher, of Yale College.

The elements of the orbit, as corrected by the method of Laplace, are stated as follows:

Perihelion distance, - - - - - 0.3366878
Time of passing the perihelion, June 27th, 11h. 56m. 28s. Mean time at Greenwich.
Inclination of the orbit, - - - 80°.56′.17″
Longitude of the ascending node, - 273°.39′.18″.4
Place of the perihelion, - - 286°.21′.33″
Motion direct.

Oxid of Manganese, and Chromat of Iron.

Mr. E. Hitchcock has shewn us specimens of oxid of manganese from Deerfield and Leverett, and he informs us that chromat of iron has been found in Cummington, Mass. twenty miles N. W. of Northampton. There is said to be a mine of manganese in Greenup county, Kentucky.

Cylinders of Snow.

Extract of a letter from Mr. E. Hitchcock to the Editor.

The Rev. Mr. Clark's account in vol. 2, p. 132 of the Journal, of the singular effect of wind upon a light snow in New-Jersey, whereby cylinders were formed having conical hollows at each end, brought to my recollection a similar fact, which I observed in Deerfield, Mass. about the year 1812 or 13. I measured the cylinders at the time and minuted the circumstances, but mislaid the account and cannot now find it. The circumstances attending the phenomenon were, however, very similar to those mentioned by Mr. Clark, except that the ground where the cylinders formed was nearly level, and none of them were more than six or eight inches in diameter. The time of this curious play among the elements, was in the night or early in the morning.

Cleaveland's Mineralogy.

A second edition of Professor Cleaveland's Mineralogy is now in the press. We are informed that it will contain many valuable additions, communicated by mineralogists in the United States. An appendix will, if necessary, be given, embracing any new facts which may occur during the printing of the work.

Sulphate of Magnesia,

Has been found by Professor Eaton and Dr. T. R. Beck about sixteen miles west of Albany.

Hudson Association for improvement in Science.

Extract from a letter to the Editor, dated May 22, 1820, *and signed by Austin Abbott, Corresponding Secretary.*

In consequence of the lectures given here last summer by Mr. Eaton, an institution has been recently formed in this city, for the purpose of studying the sciences of Chemistry, Geology, Mineralogy and Botany. We have already made a handsome collection of mineralogical specimens, although it is but little more than six months since our society was instituted. We have communication with the Troy Lyceum, and with gentlemen of science throughout the state of New-York, and have a very flattering prospect of making our cabinet respectable in a short time. The neighbourhood of the city of Hudson is interesting on account of the organic relics which are found in it. It is from this source we hope to derive some advantage, by exchanging our specimens for those of other places.

There is no doubt of the existence of gypsum, in Ancram, in this county.

[Omitted in its place.]

Fluoric acid in Mica.

Mr. Rose of Berlin, has lately examined in the Labratory of Professor Berzelius, at Stockholm, several varieties of mica, and among them a specimen of the rose mica from Goshen, Mass. sent to Sweden by Col. Gibbs. In all he found more or less fluoric acid.

REMARK.

It has been out of our power, even to peruse several original American works, forwarded to us by their authors; they will be mentioned as soon as practicable.

The transactions of the American Antiquarian Society, and particularly the researches of Mr. Caleb Atwater, (contained in them) on the antiquities of the West, are said, by our literary friends, to be very interesting and instructive.

The papers on Prussic acid, on the hydraulic lime, on Mr. Coates' electrical battery, and several others, which had been arranged for this number, are unavoidably omitted till the next.

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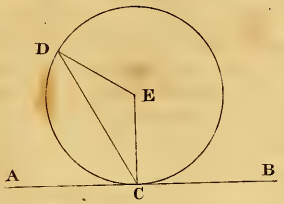

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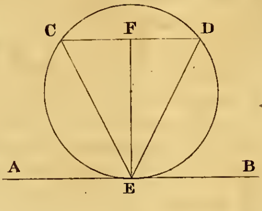

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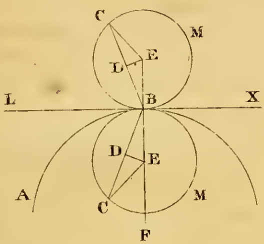

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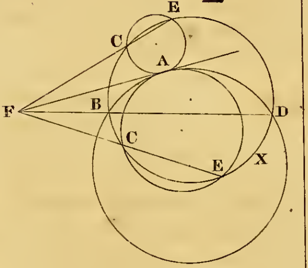

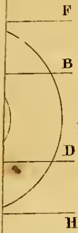

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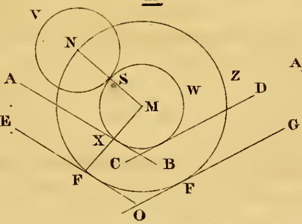

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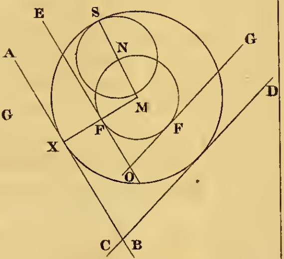

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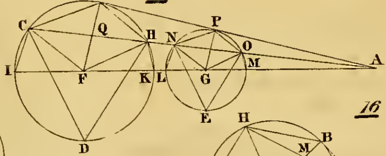

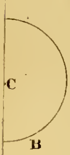

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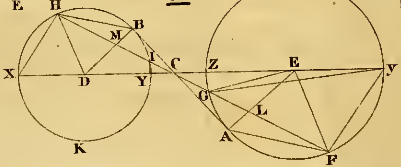
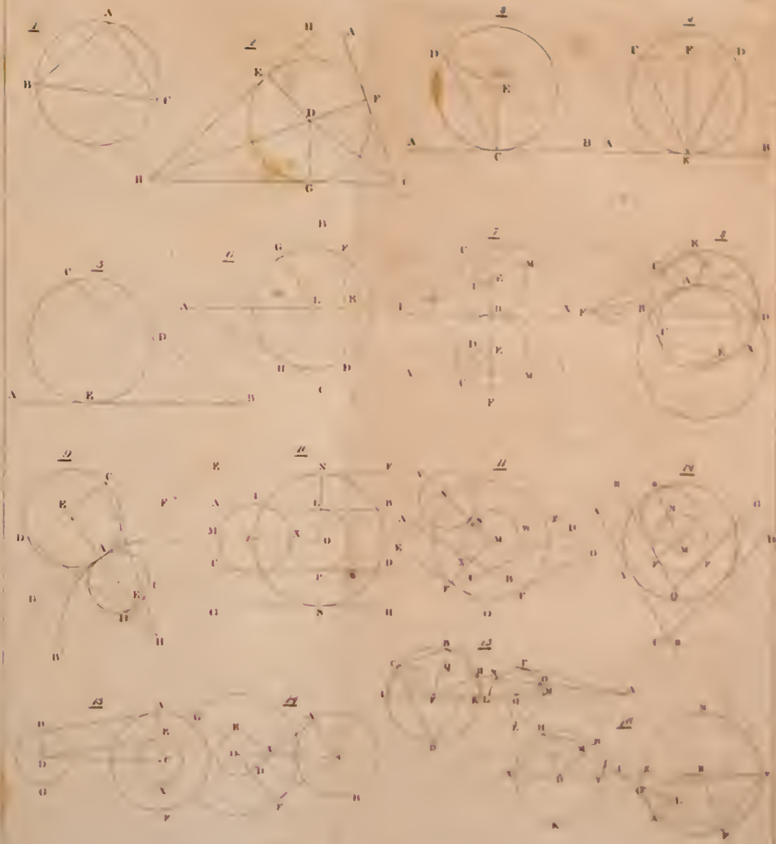


'S MATHEMATICS



STRONG'S MATHEMATICS

Fig. 8

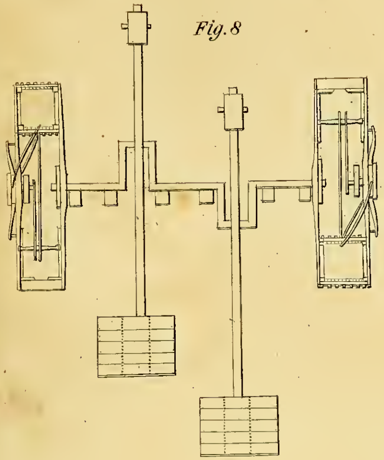


Fig. 9

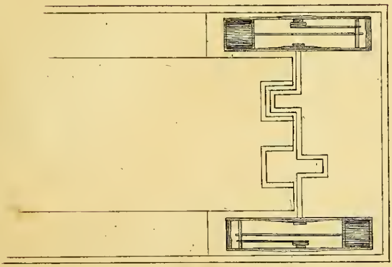


Fig. 10

N. & S. S. Jocelyn Sculpt.

SULLIVAN'S STEAM BOAT

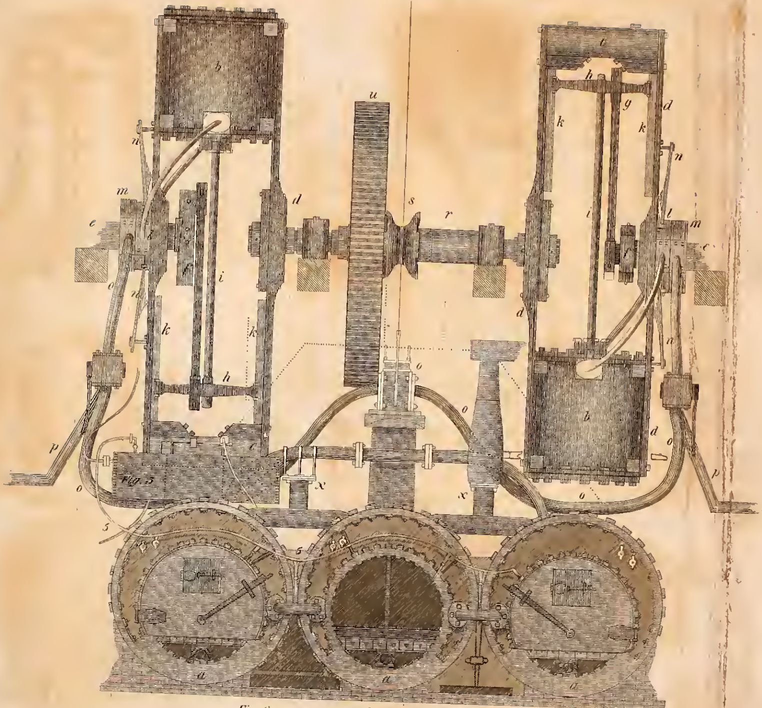


Fig. 5

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Fig. 7

Fig. 8

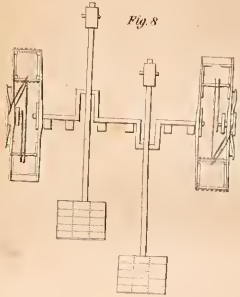

Fig. 9

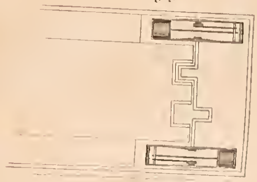

Fig. 10

W. Laughton Del.

N. & S. S. Jocelyn Sculpt

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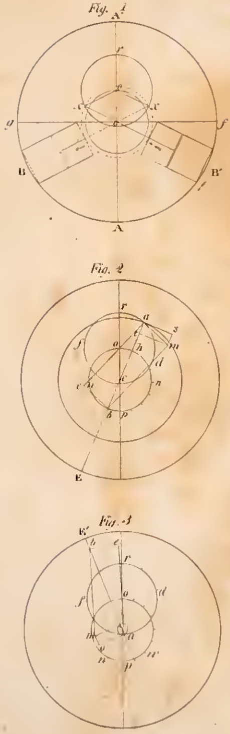
Doolittle's Figures



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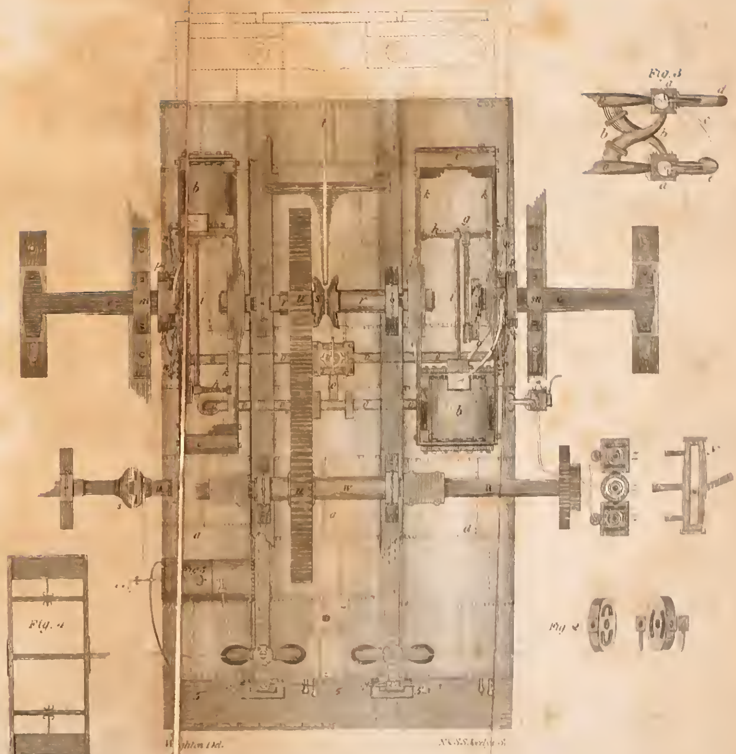
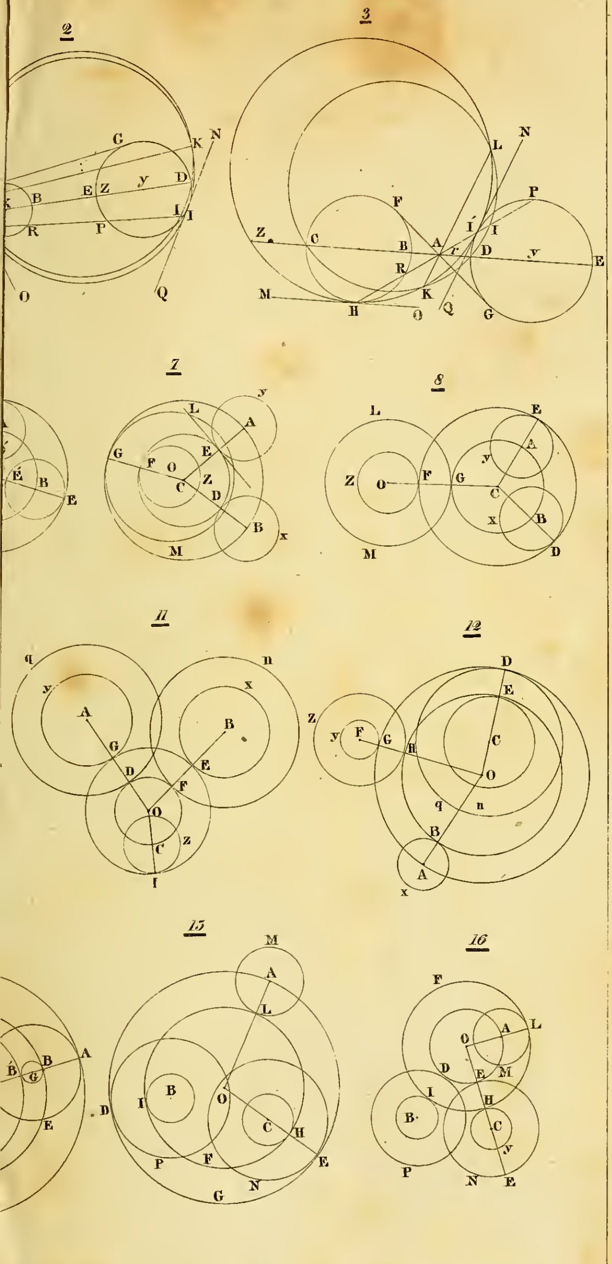
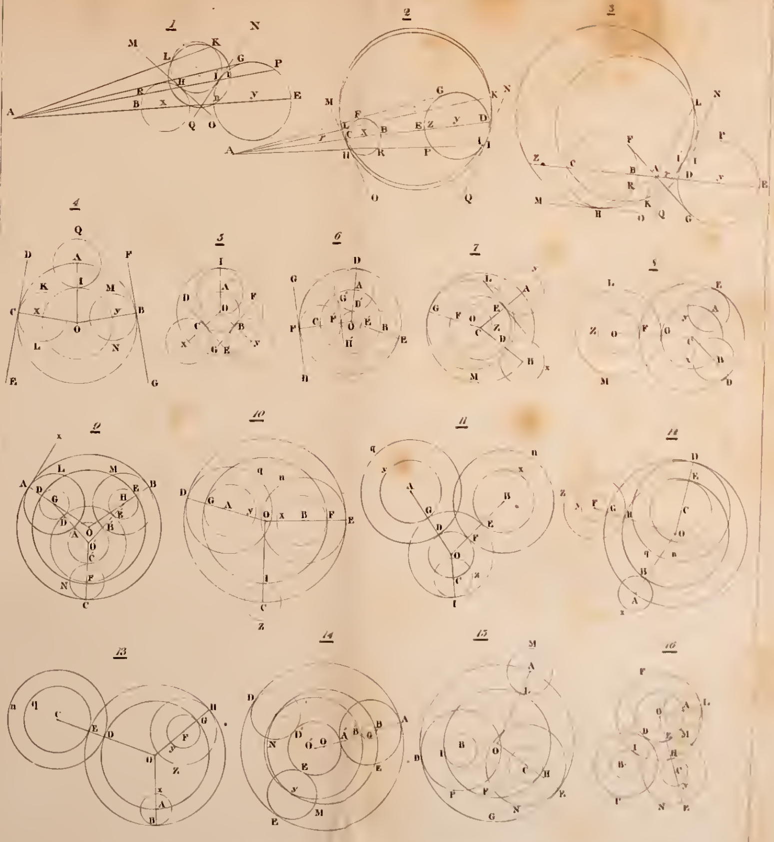




MATHEMATICS

N.&S.S. Jocelyn Sc. N.H.



STRONG'S MATHEMATICS

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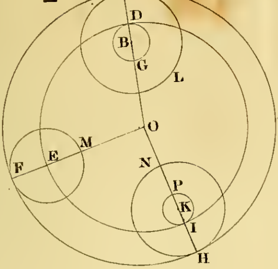

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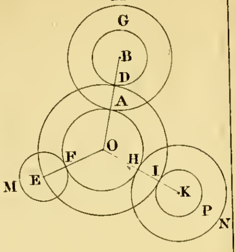

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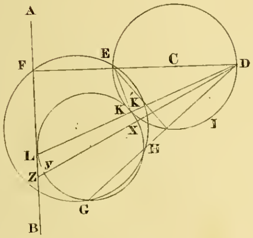

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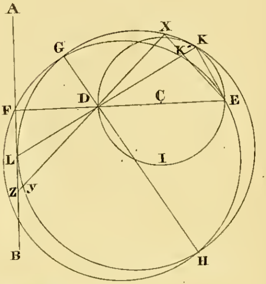

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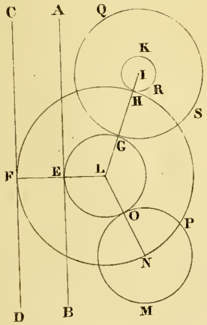

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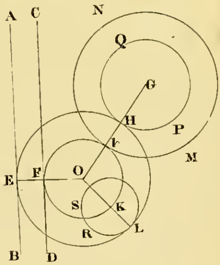

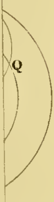

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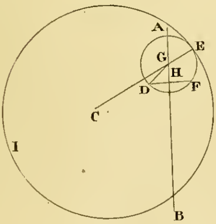

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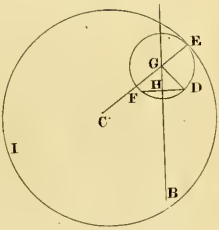

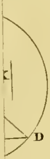

S MATHEMATICS

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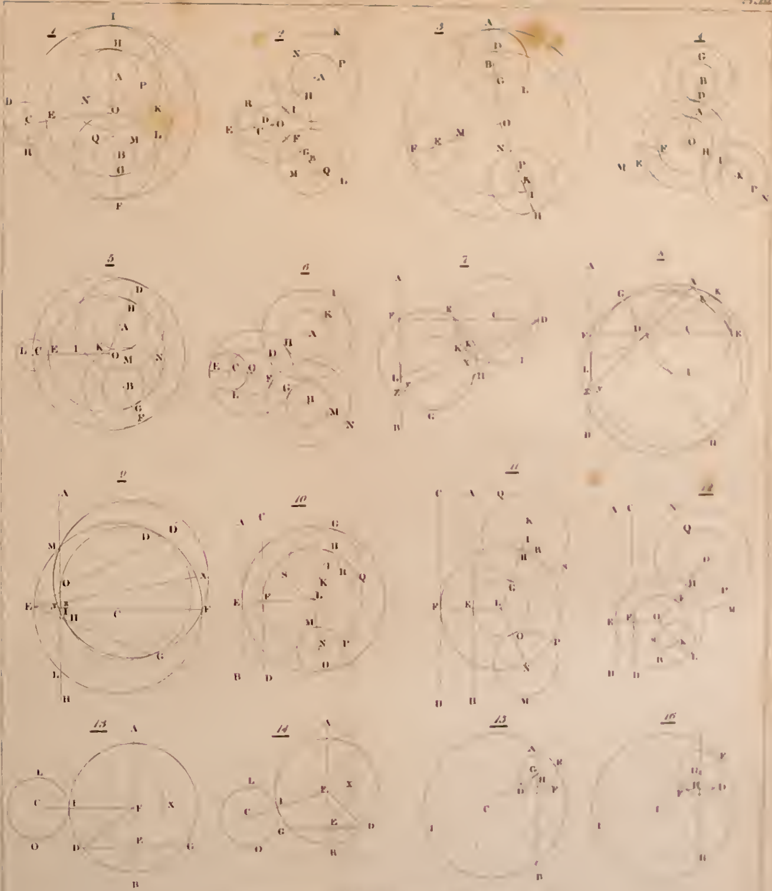

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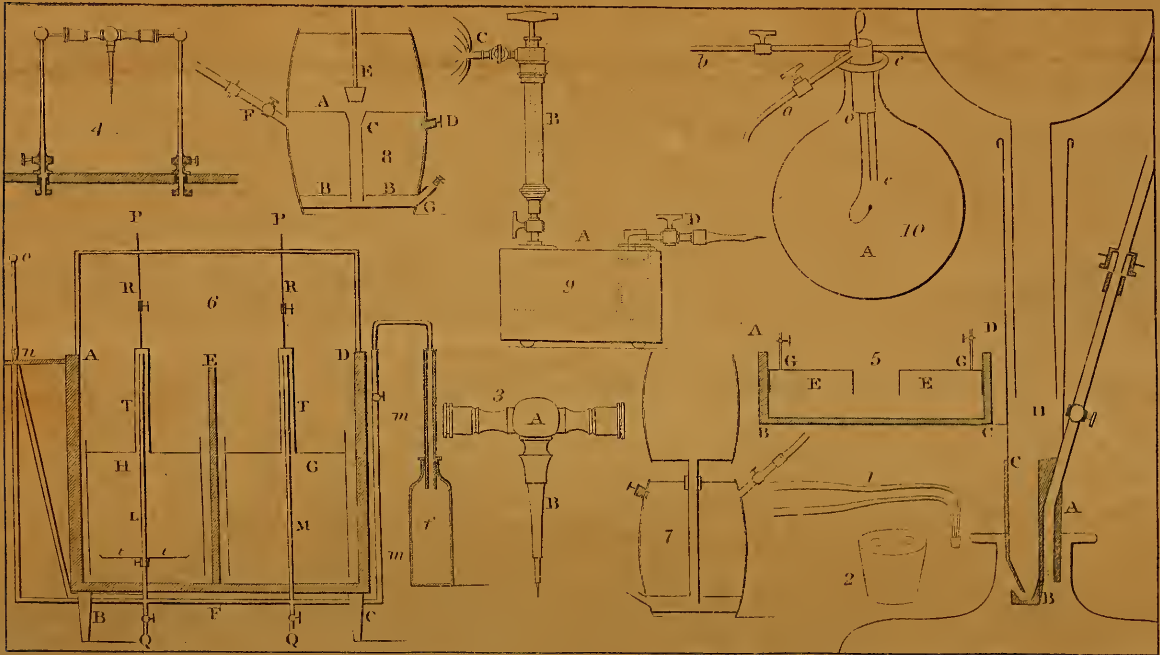

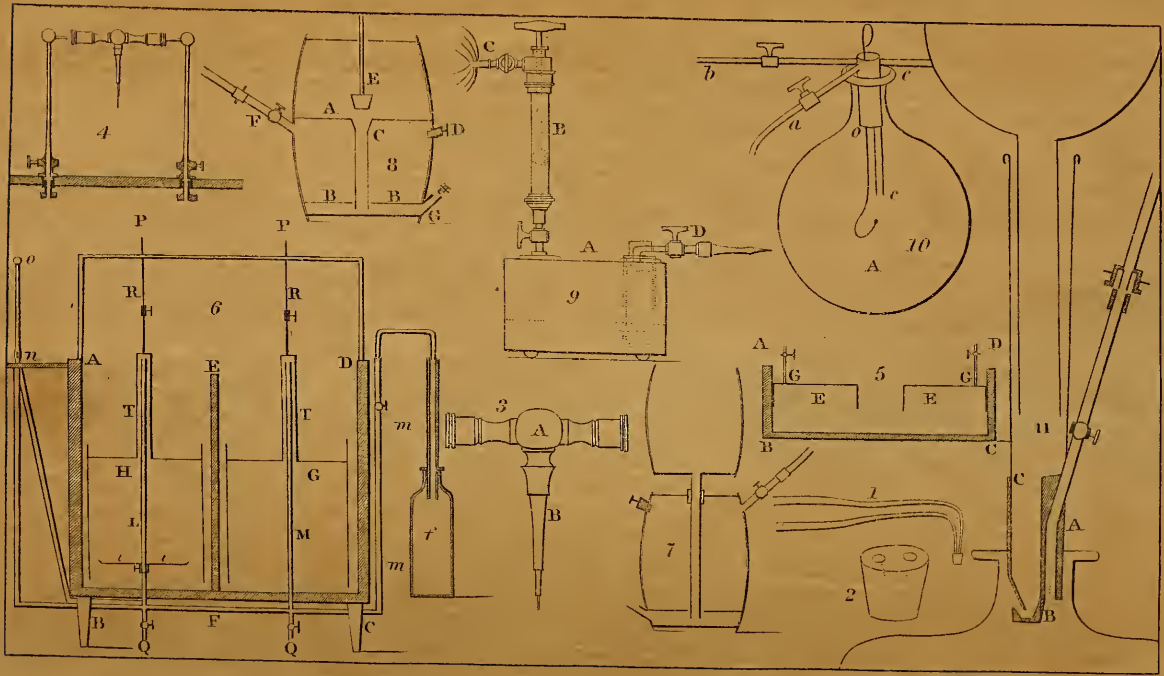

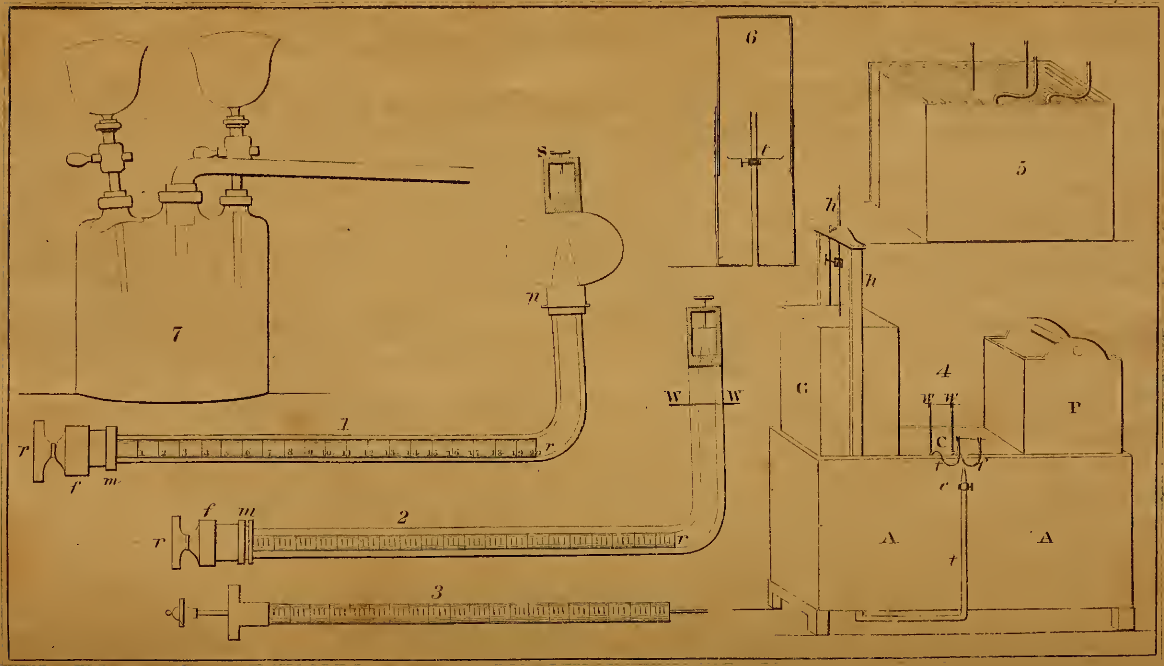
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