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NUMBER II.

* Art. IX repeated through mistake.

MISCELLANIES—DOMESTIC AND FOREIGN.

ERRATA, ALTERATIONS AND ADDITIONS.

VOL. XXII.

pp. 134, 135. Put the expressions marked (8),(9),(B),(C), each=0.

VOL. XXIV.

p. 44, lines 18 and 19. *For* $c=r^2dv$, $c'=r'^2dv$ &c., *read* $c=\frac{r^2dv}{dt}$, $c'=\frac{r'^2dv}{dt}$, &c. p. 300, lines 3, 4, 5. *For the first member of the sentence beginning,* 'A quantity, &c.' *read,* The increments of two quantities whose rates of increase are different in kind, let those increments be ever so small, cannot be compared together.

In binding, place Dr Hare's plates, as follows: evolution of silicon, now facing p. 253, to face p. 248; that on the evolution of boron, which is the second as they now stand, must face p. 250; that on the valve cock, the third as they now stand, to face p. 251. Page 237, line 2 from the top, dele *and.*

VOL. XXV.

Page 73, April 20, for *Cynoglossum,* read *Onosmodium hispidum;* May 2, dele all under this head and substitute *Argemone mexicana,* var. *albiflora,* b. b. P. 75, fig. 5, after *Argemone georgiana,* instead of the present paragraph, read—Petals from 7 to 9, white; capsules semi-valvular, 5 to 6 valved. I have seen this plant only in gardens. The genus Argemone is described by Nuttall and Elliott as having six petals, which is true in those specimens of *A. mexicana* which I have examined, and which is either native or naturalized in the streets of Newbern. It therefore becomes a question, whether the additional petals, observed in the white flowered Argemone, are the effect of cultivation, developing, entirely or partially, another whorl of petals. If this hypothesis be assumed, I do not know that this plant will be found to be more than a variety of *Argemone mexicana.*

To the article "New localities of plants," p. 77, add the following.

Tripsacum dactyloides, and *T. monostachyon.*

On Neuse River, near Newbern, and on Cape Fear River, near Wilmington. These grasses, under the name of "Gama grass," have lately acquired, in the South, considerable celebrity, and are beginning to be cultivated as a provender for horses and other cattle. Their product is said to be very great.

Elliott's description of *T. dactyloides* is defective and erroneous. It is as follows: "Spikes numerous, (3–4,) aggregate,"—and in the extended description, "Flowers in terminal spikes; spikes three to four, (when four, brachiately opposite?) bearing flowers on one (the interior) side. Fertile florets two to four, at the base of the spike," &c.

This description might be given more correctly thus: "Flowers in terminal spikes; central spikes (those of the stem) aggregate, two to four; bearing flowers, sometimes alternately on two sides, sometimes on one (the exterior) side. Fertile florets two to eight, at the base of the spike, &c.; spikes of the branches (terminal) solitary, somewhat cylindrical." (Precisely similar to those of *T. monostachyon.*)

This last circumstance, which has not been noticed by botanical writers, tends to confirm the suspicion, entertained by *Pursh,* that these are one species, varied only by accidental circumstances. Should this opinion be ultimately established, and the abolition of both specific names become necessary, I would suggest as the substitute *Tripsacum heterostachyon,* in allusion to the diversity of its spikes.

P. 88, l. 4 fr. top, for *powers* read *forms;* l. 13 fr. top, for *Souri* read *Sauri;* l. 22 fr. top, after *way* add, If $c^2+d^2=m^2+n^2$, then $2(c^2+d^2)=\alpha^2+\beta^2=\gamma^2+\delta^2$, &c.; l. 7 fr. bot., for $(\alpha^2+\beta^2)$ read $(\alpha^2+\beta^2)^2$; l. 6 fr. bot., for $(\alpha^2+\beta)^2$ read $(\alpha^2+\beta^2)^2$; p. 89, bot. line, for 2α read $2a$; p. 90, top line, for $\alpha\,.\,\alpha\beta^2\gamma^2$ read $\alpha+\alpha\beta^2\gamma^2$.

p. 96, l. 9, fr. bot. for $\frac{[y]^2}{x^{\cdot 2}}\frac{h}{2}+\frac{[y]^3}{x^{\cdot 3}}\frac{h}{2\cdot 3}+\frac{[y]^4}{x^{\cdot 4}}\frac{h}{2\cdot 3\cdot 4}$,

read $\frac{[y]^2}{x^{\cdot 2}}\frac{h^2}{2}+\frac{[y]^3}{x^{\cdot 3}}\frac{h^3}{2\cdot 3}+\frac{[y]^4}{x^{\cdot 4}}\frac{h^4}{2\cdot 3\cdot 4}$.

" 100, l. 8, fr. bot. for $\alpha\frac{n-1}{1}x^{n-2}i\alpha\frac{n-1}{2}$, read $\alpha\frac{n-1}{1}x^{n-2}i+\alpha\frac{n-1}{1}$.

l. 7. fr. bot. for $\beta\frac{n-2}{1}x^{n-3}i\beta\frac{n-2}{1}$, read $\beta\frac{n-2}{1}x^{n-3}i+\beta\frac{n-2}{1}$.

l. 6, fr. bot. for $\gamma\frac{n-3}{1}x^{n-4}i\gamma\frac{n-3}{1}$, read $\gamma\frac{n-3}{1}x^{n-4}i+\gamma\frac{n-3}{1}$.

l. 5, fr. bot. for $\delta\frac{n-4}{1}x^{n-5}i\delta\frac{n-4}{1}$, read $\delta\frac{n-4}{1}x^{n-5}i+\delta\frac{n-4}{1}$.

l. 2, fr. bot. for qi, read qi^2.

p. 101, l. 7, fr. bot. for $nx^{n-1}x$, read $nx^{n-1}x^{\cdot}$.

p. 145, l. 7 fr. bot. for *sempervirens,* read *glaucescens.*

THE

AMERICAN JOURNAL OF SCIENCE, &c.

Art. I.—*Historical Eulogy on the Marquis De Laplace, delivered at a public session of the Royal Academy of Sciences, June* 15, 1829; by M. Baron Fourier.*

Translated for this Journal, by F. Furber, Boston, Mass.

The name of Laplace has resounded in all parts of the world where the sciences are honored. His memory, however, cannot receive a more worthy homage than the unanimous tribute of the admiration and the tears of the illustrious body whose labors and glory he has shared. He consecrated his life to the study of the greatest objects which can occupy the human mind.

The wonders of the heavens, the lofty questions of natural philosophy, the ingenious and profound combinations of mathematical analysis, all the laws of the universe, were presented to his thoughts for more than sixty years, and his efforts crowned by immortal discoveries.

It was remarked, from his earliest studies, that he was endowed with a prodigious memory; all the occupations of the mind were easy to him. He rapidly acquired a sufficiently extended acquaintance with the ancient languages, and also cultivated different branches of literature. Every thing interested the rising genius, every thing could unfold it. His first success was in theological studies; he treated with talent, and with an extraordinary sagacity, the most difficult points of controversy.

We are ignorant by what happy deviation Laplace passed from scholastic to high geometry. This last science, which scarcely admits of any division, attracted and fixed his attention. After that, he abandoned himself, without reserve, to the impulse of his genius, and felt keenly that a residence in the capital had become to him necessary. D'Alembert then enjoyed all the *éclat* of his fame. He

* This gentleman, our readers are probably well aware, has been dead for some time. He himself possessed no ordinary scientific talents.—*Ed.*

it was, who had just informed the court of Turin that the Royal Academy possessed a geometer of the first order, Lagrange; ONE, who, without this noble suffrage, might have remained a long time unknown. D'Alembert had announced to the king of Prussia, that a single man in Europe could replace, at Berlin, the illustrious Euler, who had consented to return to St. Petersburgh, at the instance of the Russian government. I find, in the unpublished letters in the possession of the Institute of France, the details of this glorious negociation, which fixed the residence of Lagrange at Berlin.

About the same time Laplace commenced that long career which he was soon to render illustrious.

He presented himself at the house of D'Alembert, preceded by numerous recommendations which one would have thought very weighty. But his attempts were useless: he was not even introduced. It was then that he addressed to him, whose suffrage he had just solicited, a very remarkable letter on the general principles of mechanics, and of which M. Laplace has many times recited to me different fragments. It was impossible that a geometer so great as D'Alembert should not be struck with the singular depth of this writing. The same day, he called the author of the letter, and said to him; (these are his own words,) "*Monsieur, vous voyez que je fais assez peu de cas des recommendations: vous n'en aviez pas besoin. Vous vous êtes fait mieux connaître; cela me suffit; mon appui vous est dû.*" He obtained, a few days after, that Laplace should be nominated Professor of Mathematics at the Military School of Paris. From this moment, devoted entirely to the science which he had chosen, Laplace gave to all his works a fixed direction from which he never deviated; for the unchangeable firmness of his views has been always the principal trait of his genius. He had already touched the known limits of mathematical analysis; he had already mastered what the science then possessed of the most ingenious and of the most powerful. No person was more capable than himself of enlarging its domains. He had solved a very high question of theoretical astronomy. He formed the plan of consecrating his efforts to this sublime science; he was destined to finish it, and was able to embrace it in its full extent. He meditated deeply on his glorious design; and he spent all his life to accomplish it, with a perseverance of which the history of science can offer no other example.

The immensity of the subject flattered the just pride of his genius. He undertook to compose the *almageste* of his age; this monument which he has left to us under the name of the *Mécanique Céleste:* and his immortal work carries it as far beyond that of Ptolemy, as the analytical science of the moderns surpasses the elements of Euclid.

Time, which alone dispenses, with justice, literary glory; which consigns to oblivion all contemporary mediocrity; perpetuates the remembrance of great works. These only, carry to posterity the character of each age. Thus the name of Laplace will live in all ages. But, and I hasten to say it, enlightened and faithful history will never separate his memory from that of the other successors of Newton. She will unite the illustrious names of D'Alembert, of Clairaut, of Euler, of Lagrange, and of Laplace. I limit myself merely to cite here the great geometers whom the sciences have lost;—and whose researches have had for their common object the perfection of physical astronomy.

To give a just idea of their works it is necessary to compare them; but the limits necessary to this discourse oblige me to reserve a part of this discussion for the collection of our Memoirs.

* * * * * *

Since Euler, Lagrange has contributed the most to found the mathematical analysis. It has become, in the writings of these two great geometers, a distinct science, and the only one of mathematical theories of which we can say that it is completely and rigorously demonstrated. Alone, among all these theories, is it satisfied by itself; it enlightens all others, and is so necessary to them, that, deprived of its aid, they can remain but imperfect.

Lagrange was born to invent and to enlarge all the sciences of calculation. In whatever condition fortune had placed him, whether peasant or prince, he would have been a great geometer: he would have become so necessarily, and without any effort; a thing which we cannot say of all those, even among the first ranks, who have excelled in this science.

If Lagrange had been contemporary with Archimedes and with Conon, he would have shared the glory of the most memorable discoveries. At Alexandria, he would have been the rival of Diophantus.

The distinctive trait of his genius consists in the unity and in the greatness of his views. In every thing he confined himself to a simple, just, and very elevated thought. His principal work, the *Mécanique Analytique* can be denominated the *Mécanique Philo-*

sophique; for he brought back all the laws of equilibrium and of motion to a single principle: and that which is not less admirable, he submitted them to a single method of calculation of which he, himself, was the inventor. All his mathematical compositions are remarkable for a striking elegance, for the symmetry of the forms, and the generality of the methods, and if we can speak thus, for the perfection of the analytical style.

Lagrange was no less a philosopher than a great geometer. The whole course of his life, proved the truth of the assertion, by the moderation of his desires, by his immutable attachment to the general interests of humanity, by the noble simplicity of his customs, and by the elevation of his character; in fine, by the justness and the depth of his scientific works.

Laplace had received, from nature, all the force of genius, which an immense undertaking can require. Not only has he reunited in his *Almageste, du* 18*e siecle*, that which the mathematical and physical sciences had already discovered, which serve as the foundation to astronomy; but he has added to this science, some splendid discoveries which are peculiar to himself, and which had escaped all his predecessors. He has resolved, either by his own methods, or by those of which Euler and Lagrange had marked out the principles, the most important and certainly the most difficult questions of all those which had been considered before him. His perseverance has triumphed over all obstacles. When his first attempts were unsuccessful, he renewed them, often under the most ingenious and the most difficult forms.

Thus we observe in the motions of the moon an acceleration of which we cannot discover the cause. We had thought that this effect could proceed from the resistance of the etherial medium in which the celestial bodies move. If it were so, the same cause, affecting the course of the planets, would tend to change more, and more, the primitive order. These stars would be incessantly troubled in their course, and would end by being precipitated on the mass of the sun. It would be necessary that the creative power should interpose anew, to prevent or to repair the immense disorder which the lapse of time had caused.

This cosmological question is assuredly one of the greatest which the human understanding can propose to itself;—it is now resolved. The first researches of Laplace upon the invariability of the dimensions of the solar system, and his explanation of the secular equation of the moon, have led to this solution.

He had at first examined whether we could explain the acceleration of the moon's motion on supposing that the action of gravity is not instantaneous but subject to a successive transmission, like that of light. In this way, he could not discover the true cause. At last, a new research served his genius better. On the 19th of March, 1787, he gave to the Academy of Sciences a solution clear, and unattended with this insurmountable difficulty. He proved very distinctly that the acceleration observed is a necessary effect of universal gravitation.

This great discovery enlightened then the most important points of the system of the world. In effect, the same theory made him know that, if the action of gravitation upon the stars is not instantaneous, we must suppose it propagated more than fifty million times faster than light, the well known velocity of which is seventy thousand leagues a second.

He concluded still, from his theory of the lunar motions, that the medium in which the stars move, opposes only to the course of the planets a resistance, as it were, insensible; for this cause would above all things act upon the motion of the moon, and it produces upon it no observable effect.

The discussion of the motions of this star is pregnant with remarkable consequences. We can conclude from it, for example, that the motion of rotation of the earth around its axis is invariable. The length of the day has not changed one hundredth part of a second, for two thousand years. It is worthy of notice, too, that an astronomer would have no need of leaving his observatory in order to measure the distance from the earth to the sun. It would suffice him to observe, constantly, the variations of the lunar motion: from these he could conclude this distance with exactness.

A consequence still more striking is that which relates to the figure of the earth; for the *form itself* of the terrestrial globe is imprinted upon certain inequalities of the course of the moon. These inequalities could not exist if the earth were perfectly spherical. We can determine the amount of the earth's *applatisement*, (oblateness,) by observing the lunar motions only. The results which we have deduced from them, agree with the actual measures that have been obtained by the great geodesical voyages to the equator, to the Northern Regions, to India, and to divers other countries.

It is to Laplace, above all, that we owe this astonishing perfection of modern theories.

I cannot undertake to point out here the series of his labors, and the discoveries that have been the fruits of them. The enumeration only, however rapid it may be, would exceed the limits which I am bound to prescribe to myself. Besides his researches on the secular equation of the moon, and the no less difficult and no less important discovery of the cause of the great inequalities of Jupiter and of Saturn, we have to cite his admirable theorems on the libration of the satellites of Jupiter. We must recal his analytical works on the ebb and flow of the sea and show the immense extent which he has given to this question.

There is no important point of physical astronomy which was not to him the object of deep study and discussion. He submitted to calculation most of the physical conditions which his predecessors had omitted. In the question already so complex, of the form and of the motion of the earth's rotation, he has considered the effect of the presence of waters distributed between the continents, of the compression of the interior strata, of the secular diminution of the dimensions of the globe.

In this *ensemble* of researches, we must, above all, notice those which relate to the stability of great phenomena; no object is more worthy of the meditation of philosophers. Thus we have observed that the causes, whether casual or constant, which trouble the equilibrium of the seas, are subject to limits which cannot be surpassed. The specific gravity of the waters being much less than that of the solid earth, it thence results, that the oscillations of the ocean are always comprised between very narrow limits; which would not take place, were the fluid spread over the globe much heavier. In general, nature holds in reserve, preserving and ever present forces, which act as soon as trouble commences, and with the greater power in proportion to the increased magnitude of the aberration. They delay not to reestablish the wonted order. We find in all parts of the universe this preserving power. The form of the great planetary orbits, and their inclinations, vary and change in the course of centuries; but these changes are limited. The principal dimensions subsist. This immense assemblage of celestial bodies oscillates around a mean state, towards which it is always carried back. All is disposed for order, perpetuity, and harmony.

In the primitive and liquid state of the terrestrial globe, the heaviest particles are drawn nearest the center; and this condition has determined the stability of the seas.

Be the physical cause of the formation of the planets what it may, it has fixed upon all these bodies a motion of projection in the same direction around an immense globe. By this the solar system is become stable. The same effect is produced in the system of satellites and of rings. The order there is maintained by the power of the central mass. This power is not then, as Newton himself, and as Euler, too, suspected, an adventitious force which, one day, must repair or prevent the trouble which time had caused. It is the law itself of gravitation that governs all, suffices for all, and maintains variety and order. Having emanated once from supreme wisdom, it presides from the beginning of time, and renders all disorder impossible. Newton and Euler still knew not all the perfections of the universe.

In general, every time that there has arisen any doubt on the exactness of the Newtonian law, and that, to explain the apparent irregularities, we have proposed the addition of a strange cause, it has always happened, after a thorough examination, that the original law has been verified. It now explains all the known phenomena. The more precise the observations, the more do they conform to the theory. Laplace is, of all geometers, *the one* who has investigated these questions the most; he has, so to speak, ended them.

We cannot affirm that it was granted to him to create a science entirely new, as Archimedes and Galileo have done; to give to mathematical doctrines original principles, like Descartes, Newton, and Leibnitz; or like Newton, to transport the first into the skies, and to extend to all the universe the terrestrial dynamics of Galileo; but LAPLACE was born to bring every thing to perfection, to investigate every thing, to extend all the limits, and to resolve what had been thought incapable of solution. He would have completed the science of the heavens, if this science could be completed.

We find again the same character in his researches upon the analysis of probabilities, a science entirely modern and immense, the object of which, often misconceived, has given rise to the most false interpretations; but the application of which will one one day embrace the whole field of human knowledge, a happy *supplement* to the imperfection of our nature.

This art sprung from a single feature of the clear and fruitful genius of Pascal; it has been cultivated from its origin, by Fermat and Huygens. A philosophical geometer, James Bernouilli, was its principal founder. A remarkably happy discovery of Stirling, the researches of Euler, and especially an ingenious and important application due to Lagrange, have brought this doctrine to perfection; it has been enlightened by the objections themselves of D'Alembert, and by the philosophical views of Condorcet. Laplace has reunited and fixed its principles. From thence it has become a new science, subject to a single analytical method, and of a prodigious extent. Rich in common applications, it will one day enlighten up with a vivid light all the branches of natural philosophy. Were it permitted us here to express a personal opinion, we will add that the solution of one of the principal questions, one which the illustrious author has treated in the tenth chapter of his work, does not appear to us exact; and yet, considered in its *ensemble*, this work is one of the most precious monuments of his genius.

After having cited discoveries so brilliant, it will be useless to add that M. Laplace belonged to all the great Academies of Europe.

I could also, I perhaps ought, to recall the high political dignities with which he was clothed; but this enumeration belongs only indirectly to the object of this discourse. It is the great GEOMETER, whose memory we celebrate. We have separated the immortal author of the *Mécanique Céleste* from all the accidental facts that interest neither his glory nor his genius. In reality, gentlemen, of what consequence is it to posterity, that will have so many other details to forget, to learn whether or no Laplace was some moments minister of a Great State? That which is of importance, is the eternal truths which he has discovered; it is the immutable laws of the stability of the world, and not the rank which he for some years occupied in the senate, called *conservateur*. That which is of importance, gentlemen, and still more so perhaps than his discoveries, is the examples which he has left to all those to whom the sciences are dear; it is the remembrance of this *persévérance incomparable*, that has sustained, directed, and crowned so many glorious efforts.

I will omit these accidental, and, so to speak, fortuitous circumstances, of the particulars that have no relation with the perfection of his works. But I will say, that, in the first body of State, the memory of Laplace was celebrated by an eloquent and friendly voice, whom important services, rendered to the historical sciences, to letters, and to the State, had a long time rendered illustrious.*

I will especially recall to mind, that literary solemnity which attracted the attention of the capital. The French Academy, uniting

* M. le Marquis de Pastoret.

its suffrages to the acclamations of the country, thought that it acquired a new glory by crowning the triumphs of eloquence and of political virtue.*

At the same time she chose, as the successor of Laplace, an academician,† illustrious by more than one title; one who united, in literature, in history, and in public administration, every kind of superiority.

Laplace enjoyed an advantage that fortune does not always grant to great men. From his first youth he was justly appreciated by his illustrious friends. We have under our eyes letters still unpublished, which teach us all the zeal which D'Alembert felt to introduce him to the military school of France, and to prepare for him, if this had been necessary, a better establishment at Berlin. President *Bochard de Saròn* caused his first works to be printed. All the marks of friendship which have been given to him recall great labors and great discoveries: but nothing could contribute more to the progress of all physical knowledge, than his relation with the illustrious Lavoisier, whose name, consecrated by the history of sciences, has become an eternal object of respect and of lamentation.

These two celebrated men united their efforts. They undertook and finished very extended researches in order to measure one of the most important elements of the physical theory of heat. They made also, about this time, a long series of experiments on the dilatations of solid substances. The works of Newton sufficiently evince the high value which this great geometer attached to the *special* study of the physical sciences. Of all his successors, Laplace made the most frequent use of his experimental method; he was almost as great a *physicien* as geometer. His researches on refraction, on capillary effects, the measures of the barometer, the stable properties of electricity, the velocity of sound, the action of particles, and the properties of gas, attest that nothing in the investigation of nature could be foreign to him. He desired, above all things, the perfection of instruments; he caused to be constructed at his own expense, by a celebrated artist, a very precious astronomical instrument, and presented it to the Observatory of France.

All kinds of phenomena were perfectly familiar to him. He was connected by an old friendship with two celebrated *physiciens*, whose discoveries have enlightened all the arts and all the chemical theories.

* M. Royer-Collard.

† M. le Conte Daru.

History will unite the names of Berthollet and of Chaptal to that of Laplace. Their undertakings have always had for their object and for their result the enlargement of sciences the most important and the most difficult to acquire.

The gardens of Berthollet, at his mansion of Arcueil,* were not separated from those of Laplace. Sad remembrances, deep regrets have rendered illustrious this enclosure. It was there that Laplace received celebrated strangers and men of wealth, from whom science had derived or expected some benefactions; but above all, those whom a pious zeal attached to the sanctuary of sciences. Some commenced their career, others were soon to finish it. He entertained them *all* with an extreme *politesse.* He even carried it so far, as to have inspired the belief with those who knew not the whole extent of his genius, that he could himself reap some fruit from their undertakings.

In citing the mathematical works of Laplace, we ought especially to make some remarks upon the depth of his researches and the importance of his discoveries. His works are distinguished still by another character, that all readers have appreciated. I wish to speak of the *literary* merit of his compositions. That which bears the title of *Systeme du monde* is remarkable for the elegant simplicity of style, and the purity of language. There was still no example of this kind of productions; but we should form of it a very incorrect idea, were we to think we should be able to acquire the knowledge of the phenomena of the heavens in such writings. The suppression of signs appropriate to the language of calculation, cannot contribute to its clearness, or render the reading more easy. The work is a perfectly regular exposition of the results of a study the most profound—it is an ingenious summary of the principal discoveries. The precision of style, the choice of methods, the grandeur of the subject, give a remarkable interest to this vast tablet; but its real use is to recall to geometers, theorems, the demonstration of which was already known to them. It is, to speak correctly, a table of the contents of a mathematical treatise.

The *purely historical works* of Laplace have another object.

He therein presents to geometers, with a wonderful ability, the march of the human mind in the discovery of the sciences.

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* *Arcueil.*—So called from the arches or arcades of the aqueduct which the Romans there built: part of the aqueduct is now standing. The remainder was rebuilt and finished, in order, as is believed, to carry water to the palace of Luxembourg. Louis XIII laid the first stone on the 17th of July, 1613. It was finished 1624.

"*L'aqueduc d'Arcueil fournit aux fontains de Paris cinquant sept pouces cubes d'eau.*"

The most abstract theories have, in effect, a beauty of expression which is peculiar to them; it is what we observe in many treatises of Descartes, in some pages of Galileo, of Newton and of Lagrange. The novelty of views, the elevation of thoughts, their relations with the great objects of nature engage and fill the soul. It is sufficient that the style be pure and of a noble simplicity; it is this kind of literature that Laplace has chosen; and it is certain that in this he is placed among the first ranks. If he wrote the history of great astronomical discoveries, be became a model of elegance and of precision. No important feature escaped him; the expression is neither obscure nor aspiring. All that he calls great, is great in reality; all that he omits deserves not to be related.

M. Laplace retained, to a very advanced age, that wonderful memory which had made him remarkable from his first years: a boon, precious indeed, though not a necessary proof of *genius;* but still enabling him to *acquire* and to *preserve.* He never cultivated the fine arts, but he always appreciated them. He loved the music of Italy, and the verses of Racine, and was often delighted in citing from memory, different passages from this great poet. The compositions of Raphael adorned his apartments. We find them at the side of the portraits of Descartes, of Francois Viète, of Newton, of Galileo, and of Euler.

Laplace had always been accustomed to a very light diet; he gradually diminished it to an extremely small quantity. His very delicate sight required continual precautions. He, however, succeeded in preserving it without any change. These cares of himself never had any object but that of reserving all his time and all his powers for the labors of the soul. He lived for the sciences; the sciences have rendered his memory eternal.

He had contracted the habit of an excessive application of mind, so injurious to health, but so necessary to deep studies: and yet he experienced no sensible debility, except in his two last years.

At the commencement of the disease under which he sunk, we remarked, with fear, a moment of delirium. The sciences still engaged his attention. He spoke with an unusual degree of earnestness on the motion of the stars, and then of an experiment in physics that he said was *capitale,* informing persons whom he thought present, that he would soon go and entertain the Academy with these questions. His strength left him more and more. His physician,* who deserved his entire confidence by superior talents and by attentions that friendship only could suggest, watched near his bed. M. Bouvard, his assistant and his friend never quitted him a single instant.

Surrounded by a beloved fanily, under the eyes of a spouse whose tenderness had aided him in supporting the inseparable troubles of life, whose graces and whose sweetness of disposition had made known to him the worth of domestic happiness, he received from *M. le Marquis de Laplace*, his son, impressive testimonials of the most affecting filial piety.

He appeared deeply affected with gratitude for the reiterated marks of interest given to him by the King and Dauphin.

Those who comforted him in his last moments, reminded him of the titles of his glory, and his most brilliant discoveries. He answered: "*Ce que nous connaissons est peu de chose; ce que nous ignorons est immense.*" This is, at least as far as could be gathered, the sense of his last words, scarcely articulated; as to the rest, we have often heard this thought expressed, and almost in the same terms.

His last hour had arrived: the powerful genius which had so long animated him, at last separated from "this mortal coil," and returned to the skies. He expired without a struggle.

* * * * * *

The name of Laplace honors one of our provinces already so teeming with great men, ancient Normandy. He was born March 23, 1749; he died, in the seventy eighth year of his age, on May 5, 1827, at nine o'clock in the morning.

Shall I remind you, Gentlemen, of the deep gloom that spread like a cloud over this palace, when the fatal news was announced to you? It was the very day and hour of your wonted sittings. Each of you kept a mournful silence: each lamented the fatal blow with which the sciences had been smitten. The faces of all were directed to the very spot he had so long occupied among you. A single thought was with you; every other had become impossible. You dissolved with a unanimous vote; and at this time only, have your usual labors ever been interrupted.

It is undoubtedly beautiful, it is glorious, it is worthy of a powerful nation to decree brilliant honors to the memory of its celebrated men. In the country of Newton, the ministers of State desired that the mortal remains of this great man should be solemnly deposited amid the royal sepulchres. France and Europe have offered to the memory of Laplace an expression of their regret less ostentatious, without doubt, but perhaps more touching and more true.

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* M. Magendie.

He has received an unaccustomed homage; he has received it from his own fellows in the bosom of a learned society which alone could appreciate all his genius. The voice of science in tears has been heard in every part of the world where philosophy has penetrated. We have before our eyes multiplied communications from all parts of Germany, England, Italy, New Holland, of the British possessions in India, of the two Americas; and we find in them the same sentiments of admiration and of regret. Certainly the universal sorrow of the sciences, so nobly and so freely expressed, has no less truth and glory than the sepulchral pomp of Westminster.

Let me be permitted, before terminating this discourse, to add here a reflection which is presented of itself, when I have brought to your recollection within these limits, the great discoveries of Herschel, but which is applied still more directly to those of Laplace.

Your successors, gentlemen, will see accomplished the great phenomena of which he has discovered the laws. They will observe in the lunar movements, the changes which he has predicted, and of which he only has been able to assign the cause. The continual observation of the satellites of Jupiter will perpetuate the memory of the discoverer of the theories which govern its course. The great inequalities of Jupiter and of Saturn, pursuing their long periods, and giving to these stars new situations, will incessantly bring to mind one of his most astonishing discoveries. Here are the titles of true glory, which nothing can annihilate. The appearance of the heavens will be changed; but at these distant epochs, the glory of the discoverer will last forever: the traces of his genius will bear the seal of immortality.

I have presented to you, gentlemen, some anecdotes of an illustrious life consecrated to the glory of science; may your remembrances supply the defects of such feeble accents! may the voice of the country, may that of all humanity, be raised to celebrate the benefactors of nations, the only homage worthy of those that have been able, like Laplace, to enlarge the domains of thought, and to testify to MAN the DIGNITY OF HIS BEING, by unfolding to view THE WHOLE MAJESTY OF THE HEAVENS!

Brief chronological sketch of the Life of Laplace; by the Translator.

1749.—Born 23rd of March.

1773.—Member of the Academy of Sciences, and soon after, Member of the National Institute, and also Member of the Board of Longitude.

1775.—Commenced his theory *des Marées.*

1776.....1783.*—Succeeded Bézout as examiner of the Royal Corps of Artillery.

1782.—Demonstrated "*d'une manière bien plus générale*," that the flattened ellipsoid was the only body that satisfied the previously discussed equilibrium of the Planets. Demonstration published in 1784 as below.

1784.—Published his work through De Saron, entitled, "Theory of the motion and Elliptical Figure of the Planets."

1784?—June 24. Sat up four days with Lavoisier in forming water with oxygen and hydrogen. These experiments were repeated before the Academy in January and February, 1785, and subsequently and decisively confirmed by a series of experiments begun on the 23rd of May, and ended on the 7th of June 1788, at the Royal College, by M. Lefevre de Geneau.

1785.—Theory of the attractions of spheroids and of the figure of the Planets—published, 4to.

1787.—Dec. 19. Announced the cause of the moon's acceleration.

1788.—Announced his theory of Jupiter's satellites, in the *Mémoires de l'Academie*, which appeared in 1791.

1789 and 1790.—Continued his *Théorie des Marées.*

1796.—Dedicated to the council of Five Hundred his "*Exposition du Systeme du Monde.*"

1799.—Published Vols. I and II of the *Mécanique Céleste.*

1799.—Appointed by the Consular Government on the 18th of Brumaire, (9th of November,) Minister of the Interior.

1799.—Transferred again to the Conservative Senate.

1803.—Published Vol. III of the *Mécanique Céleste.*

1803.—Chosen Vice President of the *Sénàt Conservateur.*

1803.— do. Chancellor " do. with the title of Grand Cordon of the Legion of Honor.

1805.—Published Vol. IV of the *Mécanique Céleste.*

1811.—Nominated Counsellor to the Maternal Society, and President of the same.

1812.—Théorie Analytique des Probabilités.

1813.—Grand Cordon of the Re-union.

1814.—After having been Count of the Empire from 1806, and received great favors from the throne, he deserted his Imperial Master, and obtained a Peerage from Louis XVIII, at the Restoration.

1814.—*Essai Philosophique des Probabilités.*

1816.—Nominated a member of the French Academy and President of the committee for the reorganization of the "*Ecole Polytechnique.*"

1817.—President of French Academy.

1821.—*Précis* of the History of Astronomy, 8vo.

1825.—Fourth supplement to the *Theorie des Probabilités.*

1825.—*Mécanique Céleste*, Vol. V.†

1827.—Died May 5th.

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1827.—Supplément au 5e volume du Traité de *Mécanique Céleste.* (Imprimé sur le manuscrit trouvé dans ses papiers.)

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* Bézout died in 1783.

† The four first volumes of this work, were translated and made ready for the press, by the Hon. Nathaniel Bowditch of Boston, between 1815 and 1817; but the publication was delayed in the hope, that the revered author might make some essential changes and modifications. The appearance of the fifth volume, in 1825, and the death of the author, in 1827, having however, extinguished this hope, the learned and indefatigable translator, determined to publish the work at *his own expense*, and to decline the proffered aid of the American Academy. To the honor of the country, two volumes have seen the light: the third will probably appear in the course of next year, and we may hope that the two remaining volumes will follow at intervals of two years. This time being rendered necessary on account of the translator's laborious occupation.

Art. II.—*On Aërial Navigation; by* H. Strait.

TO PROFESSOR SILLIMAN.

Dear Sir—Having spent a considerable portion of my time, for two years and a half past, in studying and investigating the properties of the air, for the purpose of determining the practicability and utility of aërial navigation; I have so far succeeded in my inquiries as to be induced to forward you the result, wishing that you may lay it before the public in the next number of the American Journal of Science and Arts. The reasons why I wish to lay my researches thus prematurely before the public, are, that I have made experiments on my plan to a considerable extent; even enough to satisfy myself of its success; but that I am not now able, and, perhaps, shall not be before next spring, for want of funds, to construct a machine of a sufficient size to determine its practical utility, which will probably cost from one hundred to one hundred and fifty dollars; and that I have written a number of letters, to different places, descriptive of my plan and its principles, some of which are unanswered and have likewise made communications personally to individuals with whom I was very partially acquainted. I will now give a plain and concise description of my plan and its principles, hoping you will lay it before the public, and thus prevent any one from gaining an unjust precedence, or taking undue advantages of my present circumstances in the prosecution of this enterprise, with which I feel deeply interested. In so doing you will confer a favor on me, and perhaps, in time on the best interests of literature and science.

I shall now proceed to develope the true principles of aërial navigation as founded in reason and the established laws of nature, and describe a plan which I discovered in the autumn of eighteen hundred and thirty, which seems every way applicable to the purpose. Its resistance to progression will be very small; its principles are capable of being employed with equal facility on a small or large construction, according to the weight required to be conveyed. It is calculated to have the combined assistance of inflammable or rarefied air, and the percussion of wings. The inflammable or rarefied air is to supply the principal means of ascent or ascensive power, and this power is to be governed and varied at pleasure by the percussion of wings. The wings are to be so constructed and hung as to be moved with the greatest facility, whatever be their size, shape and weight.

The materials of which they are constructed, ought to be the lightest, strongest, and most durable that can be procured, the different parts compactly joined, and susceptible of considerable elasticity. They can even be made, on this principle, so light as to be only a very little heavier, in proportion to their surface, than birds' wings, and equally creative. The wings are calculated to supersede the utility of the Parachute, to accelerate or retard ascent or descent at pleasure, to insure progression and prevent fatal consequences from the rarefied or inflammable air envelopes' being burst or torn when elevated high above the earth.

Figure 1.

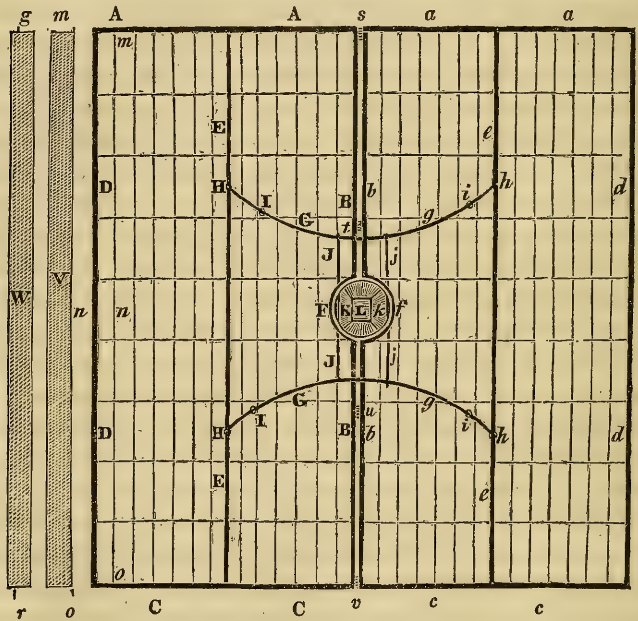

Figure 1.—In this representation of the wings, AA, BFB, CC, and DD represent a light, strong wooden frame, twice as long as wide. EE, a strong rod firmly fastened by its ends to the middle of the sides AA, CC, of the frame, which is to be the axle or pivot of the wing. All the hair lines represent strong wires with which the frame is woven and cross-woven to strengthen it, and on which the valves are to be hung. The frame being constructed and wired, the valves are then to be hung, whose purpose is to admit the passage of the incumbent air downwards so that the wing can be raised with a great deal less resistance than depressed. V represents a valve, which is a long, thin, narrow, and light strip or slip of pasteboard, stiffened cloth, tin or metal, a little wider than to cover one interstice between the wires that run parallel to the axle EE so as to overlap, and as long as DD or EE. The side of the valve V, *m*, *n*, *o*, is to be moveably attached or fastened to the wire *m*, *n*, *o*, on the under side of the frame, so as to open about thirty or forty degrees downwards, and then shut. The cross wires, parallel to AA and CC, are designed to prevent its striking through, as well as its overlapping a little the side DD. The valve V being hung, another valve of the same size and shape is to be moveably fastened by one of its longest sides, to the next wire towards the axle EE; and another to the next and so on till valves are moveably fastened to all the parallel wires, between the side of the frame DD and its axle EE. The valves are to lap on the sides of the frame a little and overlap one another sufficiently to be air tight. The valves being all moveably hung between the side of the frame DD and its axle EE by one of their longest sides to the wires, are to be restrained from opening any farther than is required, by small strings or cords being fastened to their other longest sides, and then attached to the side DD of the frame. The valves, being all moveably hung and restrained between DD and EE, the other half of the frame of the wing is to be similarly valved and have the valves restrained by small strings or cords to the side of the frame BFB. The hanging of the valves must commence at the side BFB and continue to the axle EE. *aa*, *bfb*, *cc*, and *dd* represent another similar frame, similarly wired and valved; *ee*, its axle or pivot. W represents a balance valve, *gr*, its balancing wire; when the frame is to be hung with this kind of valves, it is to be wired only parallel to its axle. The valves are to be attached on the under side of the wings to the wires, so as nearly to balance; their greater part must hang down and be similarly restrained as the others; when they shut, they must overlap a little and the materials of which they are made must be pretty stiff. These two similar frames are to be hung or fastened together at *stuv*, by hinges, susceptible of a motion upwards and downwards. Gg and Gg represent strong semi-circular rods, whose ends are attached or fastened to the under side of the axles EE, *ee*, at HH and *hh*, by hinges or small staples, so as to allow the axles a balancing motion. I, *i*, I, *i* represent four joints in these semi-circular rods, designed, when the sides of the wings BFB and *bfb* are raised, as they are attached by hinges at *s*, *t*, *u*, *v*, to admit the axles EE, *ee*, advancing towards, and receding from each other equally. JJ and *jj* represent two strong rods which connect, or are fastened to the two strong semi-circular rods G*g*, G*g*, at equal distances from their center. L represents the car which is firmly fastened to the rods JJ, *jj*, at their center. F*f* represent the space between the wings, which the aëronaut or their mover occupies, who is to stand upright in the car and take hold of the handles of the wings, K, *k*, or the middle of their sides BFB, *bfb*, on each side of him, when he wishes to move them. Having now illustrated one application of the principle of a balance to the motion of wings, and the manner of constructing them, I shall now proceed to illustrate another, on the best possible construction, before I explain how they are moved.

Figure 2.

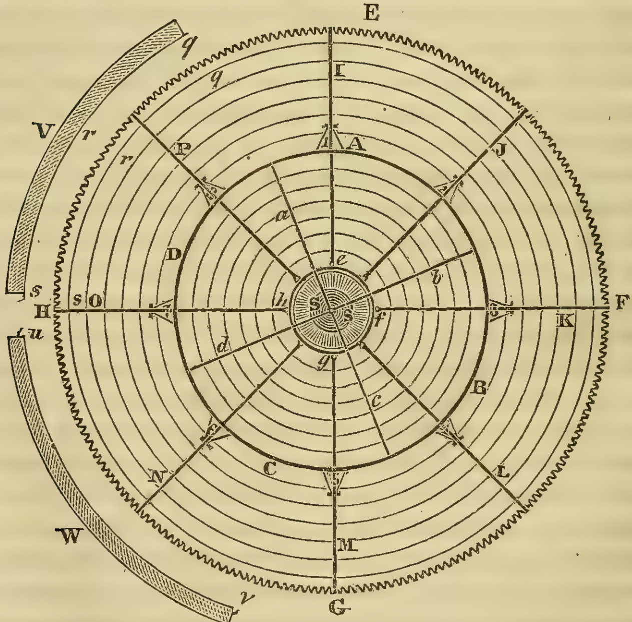

Figure 2.—I, J, K, L, M, N, O, P represent strong flattened shafts. The circular jagged line, EFGH, represents a strong spiral wire, which is to be fastened to the circumferential ends of all the flattened shafts. *efgh* represent a light, strong hoop to which the other ends of the flattened shafts are to be firmly connected by hinges or small staples so as to admit of motion upwards and downwards; its size must be sufficient for a person to stand in, and move his hands freely. All the circular hair lines between the spiral wire EFGH, and the hoop *efgh*, represent small wires woven through the flattened shafts. On these wires the balancing valves are to be hung, the same as in figure 1, only that the slips must be circular, of various sizes, and it will require a number to make one whole circular valve; part are restrained to EFGH, and part to *efgh*. W represents a circular balancing valve, *uv*, its balance wire. Or these circular wires can be cross wired and the valves similarly hung as those first described. ABCD represent a large, strong, wooden ring or hoop whose circumference or diameter must be somewhat less than the circumference or diameter of the middle of all the flattened shafts. *ac*, *bd*, represent two strong rods firmly fastened by their ends into the circumference of the hoop or ring ABCD at right angles to each other. SS represent the car which is to be strongly fastened to the rods *a*, *c*, *b*, *d*. 1, 2, 3, 4, 5, 6, 7, 8 represent standard braces, which are to be each about two feet long: two standards make one brace, and there must be one brace to every flattened shaft; the upper ends of the standards of each brace are to be firmly joined, while their lower ends should spread about a foot. The upper end of each brace is to be moveably hung by hinges or staples to the middle of each of the flattened shafts, or that part of each shaft, where the weight and superficies are nearest balanced. The other ends of the brace must likewise be moveably fastened, by hinges or staples, to the ring or hoop ABCD, when the braces are hung to the flattened shafts and the ring or hoop ABCD; their lower ends ought to incline in, towards the car, so as to make an angle of about forty degrees, with a vertical line or that of gravity. The frame being constructed, wired and valved, the aëronaut is to enter the car, stand upright and with his hands take hold of any two opposite sides of the hoop *efgh*, and raise it up and down, when it will give the wing or wings the intended motion. I shall now illustrate the balancing principle of motion.

In figure 1, as all the weight is to be suspended from the axles EE, *ee*, and all the valves are hung on the underside of the wings, so as to open about forty degrees downwards, when the aëronaut raises the handles K, *k*, quickly up, all the valves between the axles EE, *ee*, open and let the incumbent air through, while those beyond close air tight, and strike the air proportionally to the quickness of the motion. When he brings the handles down quickly, all the valves between the axles EE, *ee*, close, air tight, and strike the air similarly, while those beyond open, and let the incumbent air through. Both wings being fastened together moveably by the hinges at *s*, *t*, *u*, *v*; when the handles are raised up, the axles advance towards the car, and when brought down from it, to allow their motion by means of the joints I*i*, I*i*, in the semi-circular rods G*g*, G*g*. The aëronaut, in moving wings on this plan, has a purchase of one half of each wing to strike the air beyond the axles, and his own weight suspended on the other, the air within, besides the alternate reaction, arising from their percussion, which is proportional to the power applied on each side of the axles EE, *ee*. Whether the handles are moved upwards or downwards, the wings strike the air equally and constantly on each side of the car, and alternately on each side of their axles, during their motion, and the reaction of the air assists so as to move them equally and constantly. The wings being balanced on their axles and the valves nearly so on their wires, it is evident that their weight is no impediment to their motion. Wings of any shape and size, being wired, valved, and balanced equally on each side of their axles, can be governed and moved by a small power or force, and the better and the more effectually as the power or force is increased. This principle of a balance can be likewise beneficially applied in submarine navigation, either to ascend, descend, or move forward in the water. In figure 2, when the aëronaut raises the hoop *efgh*, quickly, all the valves between it, and the middles of the flattened shafts I, J, K, L, M, N, O, P, or where the upper ends of the braces 1, 2, 3, 4, 5, 6, 7, 8, are moveably hung to them, will open and let the incumbent air through; while those beyond will close, air tight, and strike the air proportionally to the quickness of the motion; when he brings the hoop quickly down, all the valves between it and the middle of the flattened shafts will close air tight and strike the air similarly; while those beyond will open and let the incumbent air through. When the hoop is raised, (as all the flattened shafts are moveably hung to it,) the upper ends of all the braces, (being likewise moveably hung at both ends,) move inwards towards the car, while when it is brought down, they move outwards and thus allow the motion of a balance to the whole surface of the wing or wings. The percussion being equal all around the car, there is properly but one wing on this construction. This wing strikes the air equally all around the car, at equal distances, when moved and prevents the escape of the air at any part within its circumference. Having described two applications of the principle of a balance to the motion of wings, to give it an easier illustration, let a stiff, thin board, two feet wide, and ten long, be perfectly balanced and moveably hung to the sharp edge of another, let a handle be attached to one of its extreme ends to move it. Now the fluid or air in which it is, being of a uniform density, it is evident that the least possible power or force that can be applied to this handle, either upwards or downwards, will move it notwithstanding its size and weight. If this board were valved and moved or balanced swiftly its percussion would grow more powerful by the alternate and constant reaction of the air on its under sides.

Having described the manner of constructing, hanging and moving wings upon a principle which will render their motion easy and almost independent of weight, shape, or size; and percussion powerful and constant; I shall now proceed to illustrate the manner of suspending or fastening the wings to a balloon, filled with rarefied or inflammable air, whose ascensive power must be nearly sufficient to overcome or balance all the gravity or weight of the whole apparatus, including the balloon, net-like envelope, pilot car, passenger or observer car, pilot, passengers or observers, ballast, and all other things intended to be carried or conveyed. It is evident from observation, that a vessel or body that will move with the least resistance in any one fluid, will move equally well in another, in proportion to their density, if that only is variable. Therefore vessels or bodies that move with the least resistance in water, will likewise move the easiest in the air, the water being only a fluid of considerably greater density than air. The shape of the balloon should, therefore, be oval or basi-conical, or that of two cones joined together at their bases, or partly resemble the hulk of the vessel to insure progression. A balloon being made of a sufficient size, of the shape or form of the least resistance to progression, and filled with rarefied or inflammable air, so as to balance, by its ascensive power, nearly all the weight intended to be carried is to be surrounded by a net-like envelope of small cords, so as to cover about four fifths of its whole surface, while the remaining fifth, uncovered, is to be on its under side. The wings represented in figure 1, are to be hung or fastened about five or six feet below the balloon, by their axles EE, *ee*, being attached longitudinally to the ends of the cords of the net-like or reticulated envelope; and at equal distances. The wing or wings, represented in figure 2, are to be suspended at the same distance below the balloon, by means of the ends of the cords of the envelope, being fastened at the middles of the flattened shafts I, J, K, L, M, N, O, P, in equal numbers and at equal distances, all around the car SS.

Having now shown the proper shape for a balloon and the manner of attaching wings, represented in figure 1 and 2, to it, I shall now describe the pilot car, passenger or observer car and their uses. The pilot car is represented in figure 1 by L, in figure 2, by SS. It is to be immediately attached to the wings and only of a sufficient size for one person unless the wings are very large. This car is to be occupied only by the mover of the wings, who is to be the pilot and governor of the balloon and all its courses and motions. It is to be supplied with a small compass and chart of the country over which it is intended to sail, a light seat to be occupied by the pilot in descent or when the wings are at rest; and a valve in its bottom opening upward sufficiently large for the passage of the pilot either in or out, or upwards or downwards. Its depth is to be such, that when the pilot stands upright and the wings lie level on the air, his hands, when suspended, will be even with them or their handles K, *k*, *e*, *f*, *g*, *h*. The passenger or observer car is to be suspended about five or six feet below the pilot car, or ten or twelve below the balloon, by means of strong cords, immediately fastened to the lower edge of the reticulated envelope of the balloon, and extending through the wings at their axles, so as not to be anywise dependent for elevation on their percussion. This car is intended to be the deposit of all things carried in the air, or conveyed through it, passengers, observers, observing and meteorological instruments, ballast, necessaries, &c. except those specified for the pilot car. If the balloon is designed to carry but one person, he is to occupy the pilot car, while a few pounds of ballast must occupy the passenger or observer car, to keep the wings steady during motion, and in case the balloon should break or burst, to prevent its overturning, or vacillating too much during the descent. The size, weight, and strength of this car and its attachment to the balloon, must correspond with the size or ascensive power of the balloon, the number of passengers, observers, &c., or the intended weight to be carried, or gravity overcome; while that of the pilot car will be uniform. The pilot car is intended to occupy an intermediate position between the ascensive power of the balloon and the gravity of the passenger or observer car, and what is in it; so that the pilot can give either the ascendency with the wings at pleasure. The passenger or observer car must likewise be supplied with a light strong cord of one hundred or two hundred feet long, a windlass and small anchor, to stop further progression, in case of necessity, during a swift wind.

Having explained my theory of aërial navigation, I will now endeavor to illustrate its princples more clearly by an example. Suppose an oval balloon, thirty feet long and twenty two feet high or wide, was filled with the lightest inflammable air, so as to raise four hundred and twenty pounds, independently of the weight of itself, net-like envelope, pilot and passenger cars, and wings, as represented in figure 2, sixteen feet in diameter. Two men enter the passenger car, both weighing two hundred and eighty pounds, and one the pilot car weighing one hundred and forty, making in all four hundred and twenty. Now it is evident that the ascensive power exactly balances or equals that of gravity and that the smallest weight added to either, will give it the ascendency or the least percussion of the wings, and consequently reaction of the air, will cause the whole to ascend till equilibrated in the air. Now both being in equilibrium, suppose twenty pounds of ballast, (as any number can be added that can be raised with ease by the percussion of the wings,) to be put in the passenger car, which will give to gravity so much the ascendency. In order to descend, vertically, in a calm atmosphere, the pilot, standing upright in the center of his car, must, by the wings, strike the air, with sufficient force to raise the twenty pounds. Having ascended sufficiently to descend vertically, the pilot has only to cease moving the wings, and the gravity of the twenty pounds will bring the whole vessel or machine down. If he wishes to descend slowly, he must keep the handles of the wings raised, and all the air under them will have to pass through the space he occupies at their center, while, if fast, the handles must be held down and all the air under them will rush out at their sides, as the valves of the wings on each side of the axles, all close air tight, in descent.

Having now shown the manner of vertical ascent and descent, I will explain the manner of progression. There are four ways of driving or impelling this vessel or machine through the air; by gravity, oblique percussion, the wind, and percussion from vertical wings, and three kinds of progression, ascensive, descensive and direct. The balloon being elevated as far as required to reach any place; the pilot, in order to impel it there, must stop moving the wings and step a little from the center of his car or line of gravity toward it, which will cause the wings to incline, while the twenty pounds will impel it forward, as it were, down an inclined plain to the intended place. The faster it is required to move forward, the inclination must be the greater. This is descensive progression. Having descended, the pilot, to reach any place by ascensive progression, must step a little from the center of his car or line of gravity towards it, which will incline the wings that way; and powerfully move them, which will strike the air obliquely, and drive the vessel along nearly in the same manner as birds impel their bodies, whose wings insure both progression and elevation at the same stroke. Direct progression is when the vessel moves or is impelled forward in a straight line either by the wind or the percussion of vertical wings. When the wind blows or moves forward to any place which it is intended to reach, it will impel the vessel to it without any exertion, more than to keep sufficiently elevated to prevent striking, and when the balloon has arrived, it can be stopped, by dropping the small anchor from the passenger car and winding up its cord around the windlass. The vertical wings are to be attached, one on each side of the pilot car, above the other wings, but to their axles, each being about two feet wide and eight feet long, and similarly wired, valved and balanced; but hung at right angles to the horizontal wings; each wing to have a handle at both ends, and their handles, when moved, must be impelled backwards and forwards, instead of upwards and downwards as they can be turned quite around so as to answer any course; they are to be moved only while the others are at rest. Perhaps a rudder wing of a small size, attached on the under side of the passenger car, nearly balanced, hung vertically but not valved, would help considerably to determine the motions of the balloon, and keep them regular.

Having now given a description of what appear to me to be the true principles of aërial navigation, and the manner of application to practice, I will offer a few reasons in farther illustration and support of the balancing principle, in the motion of wings, hanging their valves, and governing the ascensive and gravitating powers. Wings of a very large size, hung on the balancing principle, perhaps, may be moved by steam, the elasticity of condensed air or a lever. The more powerful the percussion, the reaction will be greater and the elevation quicker. In motion and effect they will nearly resemble bird's wings, be proportionally reactive when struck, and be less impeded in motion by their weight. The balance valves in their motion and effect in the air, will resemble, very nearly the large feathers of bird's wings; they ought not to be more than two or three inches wide and the others narrower. Now it is evident, that the ascensive and gravitating powers, can be balanced or nearly so, as well as the wings and their valves; and if balanced, the least addition of weight to either, or percussion will give it the ascendency. An aërial machine, whose gravitating and ascensive powers are equal, whatever be its size, shape and weight, will, by weight or percussion, move upwards or downwards, as the one or the other of these powers has the ascendency. Therefore its ascent or descent can be easily managed, so as to insure ascent by percussion, and descent by its gravity, the wings being stopped.

On these principles, an aërial machine of any size, by balancing, or nearly so, its ascensive and gravitating powers, can be made so as to carry any required weight, and it can be governed by percussion; being once well constructed, it would remain a ready vehicle fitted to move equally in every direction, and there would be no need of a valve to discharge the included air, to enable it to descend, or if there were, it would be used only in case of necessity. The ascensive powers of aërial fluids, lighter than common air, have already been determined, and I have made and hung wings on the aforedescribed principles, and found their motion very easy and their percussion very powerful; therefore the practicability, of aërial navigation, cannot be reasonably doubted. The navigation of the air will be attended with nearly the same advantages and disadvantages as that of water. The aëronaut, during a storm, is however, less liable to danger than the seaman, as he has the power of descrying it at a greater distance, and of ascent and descent at pleasure; he can rise above the danger or descend and anchor fast, or as the wind always moves from or before it, he can take its current, which will bear him from danger, if he keeps sufficiently elevated, while the seaman has no alternative, but either to anchor fast, or if that be impossible, to weather all vicissitudes and dangers. If the aëronaut wishes to move in an opposite direction to the wind, he must rise, (as the atmosphere is composed of different strata of air, moving at different altitudes, in different directions,) till he finds a favorable current, or wait till the wind in the lower strata blows right, or until it is calm. To what altitude it is possible to ascend on these principles, will depend on the balance between the density of the air and the powers of gravity; for it is evident, that the gravity is directly as the density. Conveyance by air can be easily rendered as safe as by water or land, and more cheap and speedy, while the universal and uniform diffusion of the air over every portion of the earth, will render aërial navigation preferable to any other. To carry it into effect, there needs only an immediate appeal on a sufficiently large scale, to experiment; reason has done her part, when experiment does hers, nature will not refuse to sanction the whole. Aërial navigation will present the works of nature in all their charms; to commerce and the diffusion of knowledge, it will bring the most efficient aid, and it can thus be rendered serviceable to the whole human family. I now offer my scheme to the public, expecting soon to see a practical and satisfactory demonstration of the truth of its principles.

East Nassau, Rensselaer County, N. Y., June 10, 1833.

Art. III.—*Remarks* on the connection between the Mosaic History of the creation and the Discoveries of geology, occasioned by the Lectures of Baron Cuvier on the History of the Natural Sciences, and published in Prof. Jameson's Edinburgh New Philosophical Journal in* 1832.

[Various subjects critical, historical, &c. are discussed in the paper from which these remarks are extracted, but we insert only that part which bears on the topic stated at the head of this article. They are introduced by the following passage from Cuvier's Lectures.—*Ed.*]

"The books of Moses shew us, that he had very perfect ideas respecting several of the highest questions of natural philosophy. His cosmogony especially, considered in a purely scientific view, is extremely remarkable, inasmuch as the order which it assigns to the different epochs of creation, is precisely the same as that which has been deduced from geological considerations."

This, then, is the issue, in the opinion of Baron Cuvier, of that science, which has been held by many persons to teach conclusions at variance with the Book of Genesis,—when at last more matured by a series of careful observations and legitimate induction, it teaches

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* No opinion can be heretical but that which is not true. Truths can never war against each other. I affirm, therefore, that we have nothing to fear from the results of our inquiries, provided they be followed in the laborious but secure road of honest induction. In this way, we may rest assured, we shall never arrive at conclusions opposed to any truth, either physical or moral, from whatsoever source that truth may be derived; nay, rather that new discoveries will ever lend support and illustration to things which are already known, by giving us a larger insight into the universal harmonies of Nature.—*Professor Sedgwick's Address to the Geological Society, February* 19, 1830.

us precisely what Moses had taught more than three thousand years ago.

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The first chapter of Genesis is writen in a pure Hebrew. This was the language spoken, and afterwards extensively written, by the people whom Moses conducted to Palestine from the land of Goshen. That it differed greatly from the language of the Egyptians, we have full proof in the Coptic remains of the latter, in the Egyptian proper names preserved in the Hebrew writings, and also in the circumstance that Joseph, when pretending to be an Egyptian, conversed with his brethren by means of an interpreter. Yet, in the chapter in question, we fine no foreign terms, no appearance of its being translated from any other tongue; but, on the contrary, it bears every internal mark of being purely original, for the style is condensed and idiomatical in the very highest degree. Had Moses derived his science from Egypt, either by oral communication, or the study of Egyptian writings, it is inconceivable that some of his terms, or the style of his composition, should not, in some point or other, betray the plagiary or copyist.

But the conjecture that Moses borrowed his cosmogony from the Egyptians, must rest, moreover, on a supposition that the order which he assigns for the different epochs of creation had been determined by a course of observation and induction, and the correct application of many other highly perfected sciences to the illustration of the subject, equal at least in their accuracy and philosophical precision to those by which our present geological knowledge has been obtained. Nothing less than this can account for Moses' teaching us precisely what the modern geology teaches, if we allow his knowledge to be merely human. How comes it to pass, then, that while he has given us the perfect and satisfactory results, he has been enabled so totally to exclude from his record every trace of the steps by which they were obtained? The supposition of such perfection of geological knowledge in ancient Egypt, implies a long series of observation by many individuals, having the same object in view. It implies of necessity, also, the invention and use of many defined terms of science, without which there could have been no mutual understanding among the different observers, and of course no progress in their pursuit. These terms have all totally disappeared in the hands of Moses. He translated, with precision, the whole science of geology into the language of shepherds and husbandmen, leaving no trace whatever of any one of its peculiar terms any more than of the curious steps in its progress.

But there is a phenomenon in his record still more unaccountable upon any supposition that his science is merely human. His geology, acknowledged by the highest authority in this age of scientific improvement to be thus accurate, dwindles down in his hands to be a merely incidental appendage to an enunciation of the most rational and sublime theology. This latter he did not learn in Egypt, for it was in the possession of his ancestors while they were yet inhabitants of Canaan; and we find Fetishism established in Egypt in his age, and even as early as the time of Joseph. Joseph's steward addresses his brethen as if their God were different from the gods of Egypt (Gen. xliii. 23.), and we find him afterwards stating (Gen. xlvi. 34.), that every shepherd is an abomination to the Egyptians. Herodotus has given us a piece of information, which forms a perfect commentary on this last passage, and puts us in possession of all its import. He tells us that cows, whether young or old, were, by the Egyptians, all held sacred to Isis, and were forbidden to be sacrificed; and that on this account, they more venerated that animal than any other; and he adds almost a paraphrase of the words of Joseph, "therefore, no man or woman of them will kiss a Grecian, or use his knife, or pot, or spit, or eat the flesh of animals cut with his knife." The Greeks were thus an abomination to the Egyptians, because they sacrificed the animal sacred to Isis. Now, the Hebrews were in the practice of sacrificing the same animal, for we find a heifer among the sacrifices of Abraham (Gen. xv. 9.) The proofs of the existence of Fetishism in Egypt in the time of Moses, and that the Egyptians knew not the God of the Hebrews, are complete. In Exodus viii. 26., we find Moses saying to Pharaoh, "shall we sacrifice the abomination of the Egyptians before their eyes, and will they not stone us?" In Exodus xii. 12. we find the beasts called the gods of Egypt; and in Exodus xxxii., we find Aaron, in consistency with the idolatry which he had witnessed in Egypt, making a golden calf, and saying to the Hebrews, this is thy God. Also, when Moses first presents himself before Pharaoh in Exodus v., we find the latter denying all knowledge of the God of the Hebrews.

Shall we, then, conjecture that Moses borrowed theology from the Hebrews on the one hand, and geological science from the Egyptians on the other, to compound out of them that brief but unique and perfect system of both, which is presented to us in the 1st chapter of Genesis; or, is it possible that we could adopt any conjecture more absurd, and this, too, in utter destitution of all proof that the Egyptians possessed any knowledge of geology in the sense in which we use the term?

The result of our inquiry is, that the geology of Moses has come down to us out of a period of remote antiquity before the light of human science arose; for, to suppose that it was borrowed from, or possessed by any other people than the remarkable race to which Moses himself belonged, involves us on all hands in the most inextricable difficulties and palpable absurdities.* Of that race, it has been long since justly remarked, that while in religion they were men, in human learning and science they were children; and if we find in their records any perfect system of an extensive and difficult science, we know they have not obtained it by the regular processes of observation and induction, which, in the hands of European philosophers, have led to a high degree of perfection in many sciences.

Let us now, then inquire into the true value and necessary result of Baron Cuvier's statement, "that the cosmogony of Moses assigns to the epochs of creation precisely the same order as that which has been deduced from geological consideration."

Before we proceed to that detail and comparison of particulars which are necessary in the due prosecution of the inquiry, we purpose to shew that a right understanding of the terms employed by Moses will lead us to several more agreements between his statements and the results of the modern geology, than are indicated by our common English translation. This will lead us into a critical examination of several of these terms. We do not mean to hinge much of these criticisms on grammatical niceties, but to rest them chiefly on an examination of other passages of Hebrew Scriptures, where the terms

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* We believe that the opinion of Calmet may be maintained by very extensive and highly satisfactory internal evidence, that Moses, in the book of Genesis, has transmitted to us the successive writings of the earlier Patriarchs just as the Prophets, who succeeded him, have transmitted to us that book and his own writings. We believe, likewise, with Bishop Gleig, that the opinion generally entertained of the late invention of alphabetical writing, is no other than a vulgar error, and that such writing must have been practised before the flood of Noah.

Sir William Jones when he hazarded the conjecture, or rather opinion, that the language of Noah is probably entirely lost, must have quite overlooked the internal evidences, that the original language of Genesis can be no other than the language of both Noah and Adam. But these questions are too important and extensive to be more than thus briefly alluded to in a note.

are also employed, and where the context throws such light on them as puts an end to all doubt about their true import. This is a process of criticism which is universally allowed to be quite satisfactory, where we have resources for employing it, as happens to be the case in the present instance.

To make our criticisms intelligible, without the labor of turning to the passages quoted, we shall quote the common English translation to such an extent as may be necessary.

The term, the meaning of which we shall first investigate, is "*day*" (in the Hebrew, yom). The interpretation of this, in the sense "*epoch*" or "*period*," has been a subject of animadversion, of an unnecessary severity in some cases. A careful examination of the first chapter of Genesis itself leads unavoidably to the conclusion, that our natural day of one revolution of the sun cannot be here meant by it, for we find that no fewer than three of the six days had passed before the measure of our present day was established. It was only on the fourth day, or epoch of the creation, "that God made two great lights to divide the day from the night, and to be for signs, and for seasons, and for days and for years." The very first time that the term occurs in the Hebrew text, after the history of the six days' work, and of the rest of the seventh, as if to furnish us with definite information regarding its true import, we find it employed in a similar manner to that in which we must understand it here; for, in Gen. ii. 4, we have, "These are the generations of the heavens and the earth, *in the day* (beyom) that the Lord God made the earth and heavens." The use of the term in this indefinite sense is so common in the Hebrew writings, that it would be a great labor to quote all the passages in which it is found; and we shall satisfy ourselves by at present referring to Job xviii. 20, where it is put for the whole period of a man's life, "They that come after him shall be astonished at *his day*" (yomu); and Isaiah xxx. 8, where it is put for all future time, "Now go write it in a book, that it may be for the latter *day* (leyom), for ever and ever." It is quite obvious, from these examples, that the Hebrews used the term (yom) to express long periods of time. The very conditions of the history in this chapter prove that it must be here so understood.

They who object to this interpretation of the term here, immediately quote against it the reason added to the fourth commandment, "For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested the seventh day, wherefore the Lord blessed the

Sabbath-day and sanctified it." This is, however, no more than a brief reference, and the terms of it must therefore be strictly interpreted in accordance with those of the detail to which the reference is made.

It has been said that such an interpretation goes to nullify the reasons assigned for the sanctification of every seventh revolution of the sun; but this does not follow. In point of fact, the rest from the work of creation (we use this form of speech from the example before us) did not endure only for one revolution of the sun, but has continued since the creation of man; and we have no grounds on which to establish even a conjecture of the time of its coming to a close; so that if we were urged to adopt a period of twenty four hours as the meaning of yom, that the six days of creation might literally correspond with our six working days, we should then find the apparent disagreement, which, by this process, we would endeavor to avoid, transferred to our weekly period of rest, and the rest from the work of creation.

It will surely be readily allowed, that the sanctification of the Sabbath has respect to man and his duties; and since his Creator has been made known to him, and the order of the six successive epochs in which the earth was rendered fit for his habitation; if we are to allow, what surely no reflecting mind will ever deny, that it is his duty to reflect with gratitude on the blessing he has received, and to maintain in his heart a sense of his dependence upon, and responsibility to him, who made the heavens and the earth, and all that they contain, no method could have been devised better calculated for preserving these feelings in constant activity than appointing some definite portion of time, returning at short intervals, to be devoted to the contemplations that awaken them, nor any interval more appropriate than that which so directly recalls the order of the events of the creation.

Since we have introduced the subject of the measure of our present day, we would offer an observation regarding the work of the fourth day, which includes the sun, moon, and stars. Respecting the period of their creation, geology, from its nature, gives us no precisely definite indications. The history regarding them is from the 14th to the 18th verses, and we would observe of it, that the terms employed are such as do not absolutely imply that these bodies were at this epoch first created, but admit of the interpretation that their motions were then first made the measures of our present days and seasons.

We had found it already stated in the 1st verse, that the heavens and the earth were created *in the beginning*, antecedently to the work of the six days, by which they were reduced to their present order, and the earth was peopled with organized beings. It would seem an unwarrantable interpretation to exclude the sun, moon, and stars from among the objects expressed by the general terms, the heavens and the earth. It is the most obvious interpretation, that they were then created, and were lighted up on the first day, but that it was only during the fourth epoch, that they were made, the greater light to rule over the present day, and the lesser light to rule over the present night, and to be for signs, and for seasons, and for days and for years, according to the measures of time which we now find established by them. This part of the history, then, when interpreted in consistency with the 1st verse, and without any violence to the terms, implies, in the common language of men, which, in all nations, refers the diurnal and annual revolutions of the heavenly bodies to the motions of these bodies themselves, that the earth was, during this epoch, finally brought into its present orbit.

The work of the third epoch was the appearance of the dry land, and the creation of the vegetable kingdom. The history of the latter, in our common translation, is, v. 11, "God said, Let the earth bring forth *grass* (in the margin *tender grass*), the herb yielding seed, and the fruit-tree yielding fruit after his kind, whose seed is in itself, upon the earth: and it was so." V. 12, "And the earth brought forth grass, and the herb yielding seed after his kind, and the tree yielding fruit, whose seed was in itself, after his kind." The terms grass (in Hebrew, deshe), herb (Hebrew, oeseb), and tree (Hebrew, etz), are here all put disjunctively in the Hebrew; there being only one conjunction in the twelfth verse between herb and tree, which does not affect the disjunctive character of the three terms, as it is a common practice in the Hebrew writings to couple, in this manner, the two last of a series of disjunctive terms, as, for example, the names of the four kings in Genesis xiv. 1. In the two last of these terms, herb and tree, we find a recognition of a remarkable natural distinction among the vegetable tribes, and this very circumstance would lead us to infer, that the first term, which has obviously presented a difficulty to our translators, since they have given two interpretations of it, is intended to express some class or tribe of the vegetable kingdom, naturally distinguished from herbs and trees, as they are from one another. The term in question (deshe) is a noun from a verb, which, from Joel ii. 22, we learn the meaning is *to spring, to shoot, to vegetate*, "Be not afraid, ye beast of the field, for the pastures of the wilderness *do spring* (dasheu)." In the 11th verse under consideration, we find both the verb and the noun, for the words translated "*Let the earth bring forth*" are (tadeshe haaretz), which, in accordance with the obvious sense in Joel, would be better rendered "*Let the earth shoot out.*" From this meaning of the verb, then, the noun would signify the *springing* or *shooting plant*, and as used here in contradistinction to both herbs and trees bearing seeds, it is surely not recommending any forced interpretation to suggest that it is meant to express that class of vegetables, which all botanists recognise as being naturally distinguished by the obscurity of their means of reproduction.

It tends to support this interpretation, that the Hebrew has a different term for grass, the common food of cattle (chatzir), which the lexicographers have shewn is derived from its tubular structure. Thus, in Job xl. 15, we have "he eateth *grass* (chatzir) as an ox;" and, Psalm civ. 14, "He causeth *grass* (chatzir) to grow for the cattle."

In several passages besides this of Genesis, we find *deshe* contradistinguished from both *oeseb* and *chatzir*, as in Deuteronomy xxx. 2. "As the small rain upon the *tender herb* (deshe), and as the showers upon the *grass* (oeseb);" and Psalm xxxvii. 2, "They shall soon be cut down like the *grass* (chatzir), and wither like the *green herb* (deshe);" and 2d Kings xix. 26, "They were as the *herb* (oeseb) of the field, as the *green herb* (deshe), as the *grass* (chatzir) on the house tops." These quotations shew the want of uniformity with which the English translators have rendered these terms, and go to support the sense we would assign to *deshe*.

But we must not conceal that there are three passages in which this word occurs, that might seem to imply, until closely examined, that we should not be warranted to restrict the sense of it in the manner proposed. One is in the 23d Psalm, "The Lord is my shepherd, I shall not want. He maketh me to lie down in the pastures of *tender grass** (deshe)." On this we have to observe, that the word rendered here *in the pastures*, has been rendered by the Vulgate, in various places where it occurs, and by the Septuagint in some instances, *desirable* or *beautiful places*, and their accuracy

* The marginal translation, which is the literal one.

in doing this seems confirmed by the circumstance, that the Hebrew has another term for pasture; and if this interpretation of that word be admitted, then *deshe* might signify here plants rather fitted for lying down on, as the mosses and ferns, than for pasture, which would make out a consistent image expressed in this clause or sentence, in opposition to the one derived from the abundance of pasture, which is evidently already sufficiently completed in the terms, "The Lord is my shepherd, I shall not want." This passage, then, when rightly understood, rather serves to confirm the meaning which we have suggested for *deshe*. Another passage is Job vi. 5, "Doth the wild ass bray when he hath *grass* (deshe), or loweth the ox over his fodder?" but no stress can be laid upon this, when we consider that both the ass and the horse eat, of choice, various species of ferns and equiseta, a fact which it is not unreasonable to suppose might be known to the author of a book which contains so much accurate and interesting natural history as this of Job. The plants, whatever they might be, which formed a supply for the wild ass, are at least obviously set in contradistinction to those which formed the fodder of the ox. The third passage is Jeremiah l. 11, "because ye are grown fat as the heifer at *grass* (deshe)." But there is in a great number of manuscripts a various reading for *deshe* here, by which the meaning becomes, "ye are grown fat, like a heifer thrashing, or treading, out the corn;" and several circumstances shew the latter reading to be the more probably correct one.

It remains, then, very highly probable, upon the whole, that *deshe*, in the 11th and 12th verses, is intended to express the cryptogamous vegetation.

In our observations on the terms employed in the history of the creation of the animals, we shall arrive at some important conclusions that are more absolutely certain.

The first thing that we would observe in regard to this, is, that there are two distinct words, of very different origin, which the English translators have rendered, promiscuously, *creeping creatures* or *thing*, and also *moving creatures*, following, no doubt, the authority of the Septuagint, which has given ἑρπετα for both; thus occasioning a great confusion instead of a clear and perspicuous order of creations exhibited in the Hebrew text. The first of these words is *sheretz*, as in verse 20th, in the history of the fifth day's work, "God said, Let the waters bring forth abundantly the *moving creature* (sheretz)," in the margin the *creeping creature.* This word is from a verb, which signifies to *bring forth* or *to increase*, or to *multiply abundantly*, being the very verb which is rendered *bring forth abundantly* in the 20th verse, "Let the waters bring forth abundantly," (is heretzu hamaim). We find the verb obviously having this meaning in other passages, of which we shall quote examples: Gen. viii. 17, "*That they may breed abundantly* (vesharetzu) in the earth, and be fruitful and multiply in the earth;" Exod. i. 7, "And the children of Israel were fruitful *and increased abundantly* (vaisheretzu), and multiplied, and waxed exceeding mighty, and the land was filled with them;" Exod. viii. 3, "And the river *shall bring forth* frogs *abundantly* (vesharatz), * * * and the frogs shall come up both on thee and on my people, and upon all thy servants."

From all this it appears that the proper translation of the noun sheretz is not *the creeping* but *the rapidly multiplying creature.* The creatures expressed by this noun were part of those which were created during the fifth epoch.

The other word translated *creeping thing* is (remes), and the creatures expressed by the noun were created during the sixth epoch. We shall afterwards shew that it has a very different meaning from sheretz.

In the history of the fifth day's work the translators have rendered the Hebrew word (oph), by fowl. This limits its meaning so as to include only the birds. But the term includes also the winged insects, as is evident from Leviticus xi. 20, "All fowls (haoph) that creep, going upon four."—The proper translation of the term is not *fowl* but *flying thing*, including the tribes of all kinds that can raise themselves up into the air; as is indeed rendered obvious by the expression in the 21st verse of the 1st chapter of Genesis itself (cal oph canaph), "every flying thing that hath wings."

In the 21st verse it is said, "God created (hathananim hagedolim)," which Hebrew words, our translators, following the Septuagint, which has given for them τα κητη τα μεγαλα, have rendered great whales. We have abundant resources to shew that this translation is erroneous. In fact, neither the Greek nor the English translators have been consistent with themselves in translating the Hebrew word (than) or (thanim), for it occurs in both these forms. We find them in other places translating it severally by the term δρακων, and dragon. It would be tedious to quote the passages where they have thus varied from themselves. We shall refer to Ezekiel xxix. 3. for the latter sense, "I am against thee Pharaoh, King of Egypt, *the great dragon* (hathanim hagadol) that lieth in the midst of his rivers," where the Septuagint has τον δρακοντα τον μεγαν. The figure in this passage is evidently borrowed from the crocodile of the Nile, and this circumstance of itself would shew that dragon, in place of whale, would be a better translation in Genesis. But (thanin) has a still more comprehensive meaning. We find two words formed from it, one of which (Leviathan) is the specific name of the crocodile, as is obvious from the descriptions of Job chap. xli. and of Isaiah chap. xxvii. 1, in which last passage (thanin) is also used,—and the other (Pethan) is the specific name of some serpent, as is obvious from the reference to its poison, in Job xx. 14, and Deuteronomy xxxii. 33. In this last passage we also find poison ascribed to the thanin; "Their wine is the poison of dragons (thaninim), and the cruel venom of asps (pethanim);" so that here it is evidently meant to express a serpent, as in Ezekiel and Isaiah, as we have seen above, it signifies one of the lacertine species.

These references, which we could have greatly extended, were it necessary, are sufficient to prove that (than) or (thanin) was a sort of generic, or rather classical, name, to designate the serpent and lizard tribes; and that instead of *great whales* in the 21st verse, the translators should have given the words *great reptiles.**

The result of our criticism is, that the work of the fifth epoch, as described in Genesis, was the creation of the inhabitants of the waters; of the birds, winged insects, and reptiles; in fact, of the oviparous races named in detail, with some omissions which are to be accounted for by the uniformly condensed and brief form of the whole narration.

We proceed to the work of the sixth epoch, which concluded with the creation of man.

In the English translation we find *creeping things* again included among the beings which were created during this period, and these English terms, in their most commonly received acceptation, imply some of the insect or reptile tribes. We have seen that the Septuagint countenances the interpretation *creeping things*; but the

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* Their is only one passage in which (than) means, with certainty, any thing else than a serpent or reptile, which is Lamentations iv. 3, where probably a seal is meant; but the passage is highly poetical, and no authority can be given to it to supersede the uniform meaning of the term in all the earlier writers, which we have established in the text.

Hebrew term (remes) does not. This is derived from a verb which signifies *to move*, and which is so far from being limited in its application to the insects or the reptiles, that, in Psalm civ. 20, 21, we find it applied to the beast of the forest and the young lions: "Thou makest darkness and it is night, wherein all the beasts of the forest *do creep* (tiremos). The young lions roar after their prey." In the 24th and 25th verses, (remes) is grouped with cattle (behemach), and *beast of the earth* (haith haaretz). Proofs are abundant, and too tedious to be all referred to, that by (behemah) the Hebrews generally expressed the larger herbivorous animals, and by (haith haaretz) the larger beasts of prey. (For the former see Genesis xxxiv. 23, and for the latter Leviticus xxvi. 22). Thus we find races of mammalia expressed by these terms, and to comprehend the whole class we must understand (remes) as referring to its other tribes. It is at least no race of insects that can be meant by the term, for, in point of fact, where any of these are obviously meant in other Hebrew passages, either the name (sheretz) is given to them as in Leviticus xi. 42, "Whatsoever doth multiply feet among all *creeping things*," (hasheretz), or the name (oph), as we have already seen.

It is true that remes is applied to the oviparous tribes, but not as a noun or name, but as a verb to express their motion, just as in some passages above quoted, we have seen sheretz applied as a verb, but not a name to mammalia.

Previously to setting down the following table of coincidences between the first chapter of Genesis and the results of geological observation, it is necessary to make a remark on one passage in Humboldt's table of geological formations, which possesses a classical celebrity over Europe. In that table, following an earlier authority, he has placed the formations of transition, in the limestones of which are found several species of shells, intermediately between the primitive formations and those containing bituminous coal; and his table would thus indicate that an animal creation had preceded any vegetable one. We shall not need to discuss the question, whether the formations, named transition, are considered in a right point of view, when they are placed between the primitive and pit-coal strata, since it is sufficient for our present purpose to remark, that several observations, among which we may particularly refer to those of Thomas Weaver, Esq., F. R. S., on the geological relations of the south of Ireland, have proved that the anthracite or glance coal of the transition formations, with some of its accompanying strata, are full of impressions of various plants; so that in the transition strata a vegetable creation is discovered as well as an animal.

In the following table we have taken the geological facts from various authorities. The passages quoted, are selected chiefly on account of their brevity. In the quotation from and reference to Genesis, the events on which geology can throw no certain light are in italics.

Table of coincidences between the Order of Events as described in Genesis, and that unfolded by Gological Investigation.

In Genesis.	No.	Discovered by Geology.
Gen. I. 1, 2. In the beginning God created the heavens and the earth. And the earth was without form and void; and darkness was upon the face of the deep; and the Spirit of God moved upon the face of the waters.	1	It is impossible to deny, that the waters of the sea have formerly, and for a long time, covered those masses of matter which now constitute our highest mountains;
3, 4, 5. *Creation of light.* 6, 7, 8. *Creation of the expansion or atmosphere.* 9, 10. Appearance of the dry land.	2	and, further, that these waters, during a long time, did not support any living bodies.—*Cuvier's Theory of the Earth, sect.* 7.
11, 12, 13. Creation of shooting plants, and of seed-bearing herbs and trees.	3	1. Cryptogamous plants in the coal strata.—*Many observers.* 2. Species of the most perfect developed class, the Dicotyledonous, already appear in the period of the secondary formations, and the first traces of them can be shown in the oldest strata of the secondary formation; while they uninterruptedly increase in the successive formations.—*Professor Jameson's remarks on the Ancient Flora of the Earth.*
14 to 19. *Sun, moon and stars made to be for signs, and for seasons, and for days, and for years.*		
20. Creation of the inhabitants of the waters.	4	Shells in alpine and Jura limestone.—*Humboldt's tables.* Fish in Jura limestone.—*Do.* Teeth and scales of fish in Tilgate sandstone.—*Mr. Mantell.*
Creation of flying things.	5	Bones of birds in Tilgate sandstone.—*Mr. Mantell, Geological Transactions*, 1826. Elytra of winged insects in calcareous slate, at Stonesfield.—*Mr. Mantell.*
21. The creation of great reptiles.	6	It will be impossibie not to acknowlege as a certain truth, the number, the largeness, and the variety of the reptiles, which inhabited the seas or the land at the epoch in which the strata of Jura were deposited.—*Cuvier's Ossem. Foss.* There was a period when the earth was peopled by oviparous quadrupeds of the most appalling magnitude. Reptiles were the lords of Creation.—*Mr. Mantell.*
24, 25. Creation of the mammalia.	7	Bones of mammiferous land quadrupeds, found only when we come up to the formations above the coarse limestone, which is above the chalk.*—*Cuvier's Theory, sect.* 20.
26, 27. Creation of man.	8	No human remains among extraneous fossils.—*Cuvier's Theory, sect.* 32. But found covered with mud in caves of Bize.—*Journal.*
Genesis VII. The flood of Noah 4200 years ago.	9	The crust of the globe has been subjected to a great and sudden revolution, which cannot be dated much farther back than five or six thousand years ago.—*Cuvier's Theory*, 32, 33, 34, 35, *and Buckland's Reliq. Diluv.*

* One solitary exception is since discovered, in the calcareous slate of Stonesfield, in the bones of a didelphis, a tribe whose position may be held intermediate between the oviparous and mammiferous races.

In the above table, we have not taken advantage of the distinction which, we conceive, we have gone far to prove, is expressed in the Hebrew text between the cryptogamous and the other classes of plants, but have set down the whole vegetable kingdom as forming only one element in the table. We shall also allow that the 4th, 5th, and 6th Nos. may be liable to be interchanged among themselves, in respect of place, and shall hinge no argument upon them, farther than what arises from the circumstance that they are all placed in one group. Yet, after these abatements from the number of particulars, the coincidences here shown between the order of the epochs of creation assigned in Genesis, and that discovered by geology, are calculated to excite the deepest attention. Human science, in the probability of chances, as illustrated by La Place, has put us in possession of an instrument for estimating their value; and we feel amply entitled to take advantage of it for that purpose, for no case could well be pointed out, where it would be more correctly applicable than in this, where the coincidences assume a definitely successive numerical form. We are entitled to adopt even the very language of La Place, and to say, "By subjecting the probability of these coincidences to computation, it is found that there is more than sixty thousand to one against the hypothesis that they are the effect of chance."*

It is thus, then, that the discoveries of geology, when more matured instead of throwing suspicion on the truths of revelation, as the first steps in them led some persons to maintain, have furnished the most overpowering evidence in behalf of one branch of these truths. The result of these discoveries has been in this respect similar to those of the Chinese and Egyptian histories, and the Indian astronomy, but much more striking. Eminent men had pledged their fame in setting up these histories, and that astronomy, in opposition to the chronology of Genesis; but further and more careful inquiry into their true characters, discovered that, when rightly understood, they only tend to confirm it.

We are not afraid that we shall have here quoted against us the words of Bacon, "Tanto magis hæc vanitas inhibenda venit, et coercenda, quia ex divinorum et humanorum, male sana admixtione, non solum educitur, philosophia phantastica, sed etiam religio hæretica." We have only endeavored to illustrate and point out the consequences of the statement of Baron Cuvier, "that the order which

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* Syst. du Monde, book v, chap. 6.

the cosmogony of Moses assigns to the different epochs of creation, is precisely the same as that which has been deduced from geological considerations." We have been guilty of no improper mixing up of divine and human things. We have examined the meaning of the terms in the first chapter of Genesis, in consistency with the acknowledged rules of criticism, and only by the light contained within itself, or that thrown upon it by the other books, in the same language with which it is associated. The human science we have not extracted from any part of the Holy Scriptures; we have taken it simply as we find it in the works of eminent geologists. As the latter is not a philosophia phantastica, but a deeply interesting science, constructed by that method of careful observation and cautious induction, which Bacon was himself the first to recommend; so neither can the sense of the Scriptures present to us a religio hæretica. If our science, thus constructed, and our religion speak so obviously the same language, as we have seen they do on one important point, what else in the strictest application of Bacon's philosophy, can we deduce from the circumstance, but that both are certainly true?

It does not come under our present subject to discuss the historical and moral evidences of the divine revelation of the Scriptures; but both are so full, even to everflowing, and impose upon us so many insuperable difficulties, in the way of our being able to account for the quality and consistency of these remarkable books, excepting on the ground which has been all along assumed by themselves, that they are of more than human origin, that in estimating the accuracy of any part of the matters contained in them, the fastidiousness of human science appears to be carried to an unreasonable extent, not to take these evidences into calculation. In this country, where for a long period we have had the scriptures in our hands as a popular book, they among us who have been the most eminent for human learning and science, and whose fame has been in every view the most unsullied, have been so convinced by the force of these evidences, that they have in general been the most strenuous defenders of revelation.

Will not human science, then, condescend to borrow some light, to direct the steps of its own inquiries, from a record, the accuracy of which it has itself proved, and which is supported by other proofs of the highest order? or, what should we say to the illustrator of the relics of Pompeii and Herculaneum, who should reject the light thrown on them by the letters of Pliny, authenticated as these are by the existing remains of the buried cities, as well as the historical evidence which is proper to themselves?

Among the questions which geology is at present attempting to solve, is that of a different temperature of some regions of the earth at a remote age. The discoveries of Pallas and Adams, of a rhinoceros and elephant in Siberia, having coverings of hair fit to protect them from the cold of the northern regions, would seem to decide the question, so far at least as to show, that there has been no change of temperature since the creation of animals. But the question does not seem yet so satisfactorily answered, so far back as to the age of the creation of vegetables. Does not the statement in Genesis, that the establishment of our present days and seasons was intermediate between the creation of vegetables and that of animals, give us a clew to direct our path in the inquiry?

Art. IV.—*On the Vitality of Toads, &c. enclosed in firm materials;* by the Hon. Wm. A. Thompson, of Thompson, N. Y.

Having observed in Vol. xxiii, No. 2, of the Journal of Science, an account of some experiments made by Professor Buckland of Oxford, on the long continued vitality of toads; and having reflected on these experiments, and their results, together with the conclusions drawn from them, I have been led to doubt whether the object which Dr. Buckland had in view, could be obtained in the manner and under the circumstances in which his trials were made. The reptiles were enclosed in two different pieces of stone; in the one case, in cells twelve inches deep and five in diameter, and in the other, the same number of toads were enclosed in sandstone, in cells of smaller dimensions. It appears, that at the end of a year or more, those in the smaller cells were all dead, while most of those in the sandstone were alive, although much diminished in weight. After the cells were taken up and examined, the surviving toads were enclosed again until the end of another year; they were then taken up, and all found dead. At the same time that the other toads were enclosed in the stone, four others were shut up in three holes cut in the trunk of an apple tree, five inches deep and three in diameter, and the holes were carefully closed with plugs of wood, so as to be apparently tight; at the end of a year they were all found dead.

Upon a review of these facts, it does not appear surprising, that these reptiles should, all or most of them, be found dead at the expiration of one or two years, and I doubt whether these experiments will be regarded as satisfactory. The very circumstances of these trials appear to admit the persistent vitality of these animals; for if there was any doubt as to the great length of time, that the principle of life remains unextinguished in these reptiles, Dr. Buckland would not have made the experiments.

In this country, toads and frogs have been found in three different situations.

1. Toads have been frequently found in sandstone of the secondary formation, and in secondary limestone.

2. In digging wells, where the workmen have come to beds of clay twelve or fifteen feet below the surface of the ground.

3. In the trunks of trees, which were apparently closed so as to be impervious to the air.

In the first place, the toads that have been found in the sandstone and limestone, were enclosed in cells just large enough to contain their bodies; and from every appearance, must have remained in that situation ever since the formation of the surrounding sandstone or limestone, in the water under which they appear to have been deposited.

The cells that enclose these reptiles were evidently accommodated to their shape and size, and of course, the materials of which they are composed were then in a plastic or yielding condition, so as to suit the form of any body that might become enclosed in them. Now it is obvious, that if a living healthy toad or other reptile were enclosed in a cell of the size in which they are usually found, it would not live one half of the time that those did which were immured by Prof. Buckland; for food and air are absolutely necessary to every animal that has the use of its natural organs.

But it is a well known fact, that toads, frogs, and other reptiles, have remained in a torpid state for many years, without any signs of life, and have revived, on being exposed to a higher temperature, with access of air. It is thus proved that respiration and the circulation of the blood are not necessary to the vitality of the cold blooded animals, during their hybernation; it appears, also, that the food taken into the stomach remains, unaltered and undigested, even at the end of three or four years, the same as if it had not been in the stomach more than a minute, provided, however, that the torpidity of these hybernating animals remains the same, and that they continue in the same low degree of temperature.

We have a right to suppose, that from the earliest formation of our globe, there has been a succession of seasons of heat and cold, of tides, &c. as now; and that the constitution of animals has always been regulated by the same principles as at present; if, therefore, any of these reptiles, during a state of torpidity, should be imbedded in sand or calcareous matter, we know of no reason why their vitality should not continue for thousands of years. If food, respiration, and the circulation of the blood, are not necessary for the continuance of the vitality of these reptiles, the lapse of a thousand years is the same to them as that of one day. A free circulation of air, and a higher temperature, are both equally necessary for the revivescence of these torpid animals. We have no account of the toad and other reptiles being found enclosed in sandstone or marble, in Europe or America, except in latitudes where the cold renders these reptiles torpid; it therefore appears probable that they might be enclosed in the substance when it was soft, and the reptiles in a torpid state. If it is objected that the animals should have been quickened into life by the annual return of a higher temperature, it may be answered, that a rock at the depth of fifteen or twenty feet remains at a much lower temperature than the incumbent air, and there appears great reason to doubt, whether, if a reptile should be enclosed in a rock, at the depth of fifteen or twenty feet, without a free circulation of air, it would become quickened. Frogs and toads at the south part of Hudson's Bay, and in Canada, have remained frozen and torpid for years, and afterwards revived.

Toads, in this latitude, remain torpid from the first of November until the first of May; in the summer, they usually burrow about eight or ten inches under the ground, or under some stone at a less depth; in the winter they continue in a torpid state, and remain so even until May, at which time the small insects begin to emigrate from their winter quarters, to furnish them with food.

In this climate, the earth is usually frozen during the winter season, from fifteen to eighteen inches deep, and every thing enclosed by it appears to be congealed and lifeless.

The hybernating warm blooded animals, such as the marmot, hedge-hog, pole-cat and bat, although they remain torpid during the cold season, yet the cold operates very differently on them, from what it does on the cold blooded animals, in which the circulation of the blood can be carried on, independently of the action of the lungs.

When the temperature of the air sinks below 50° Fahr. the cold blooded animals begin to lose their sensibility; when reduced to 40° they become torpid, and if continued in that temperature they might remain unchanged for any length of time, as repeated experiments seem sufficiently to prove.

As respects the toads and frogs, that, in digging wells, have been found in the clay, at the depth of twelve or fifteen feet, I see no reason to think that they may not have lain there in a torpid state ever since the deluge, as most of the materials above the solid rock strata were, at that time, removed by the violent action of the water, and these frogs and toads might have been inclosed at that time with the materials that were every where in motion; and if they were not deposited in the earth at that time, but have been since covered deep in the earth by some violent irruption of the waters, so as to deprive them of air and food, their case will still be similar, for, obviously, at the depth of fifteen feet there could be no supply of food or air, and yet when taken out of the clay, they have soon become quickened so as to move; it is therefore possible that these toads and frogs may have remained in this situation many years, or even ages,—indeed, for a period incomparably longer than any person will attribute to the life of these reptiles.

As to the toads found enclosed in the trunks of trees, it is a case much more within our comprehension; there is no direct necessity for supposing a very long continued vitality in them; it is not surprising that a toad, having crept into a hollow place in the trunk of a tree, should not be able to get out of his confinement, and that the place should, in the course of three or four years, become closed up, in the natural process of vegetation; and it is easy to admit that there might be some crevice in the wood, through which insects might enter and supply the animal with food. Again, as it is well known that our trees that are not more than two feet in diameter, are not unfrequently frozen completely through in winter, and the toads might thus become so torpid, that, having no free circulation of air, their torpidity might continue until they were extricated from their confinement. That the lives of these reptiles, when supplied with food and air, in the ordinary way, do not usually continue beyond twelve or fifteen years, we have every reason to believe,* when we consider their diminutive size, and that they attain maturity in two or three years; whereas, if we look at man—the number of years before he arrives at maturity—the long continued labor he is capable of sustaining, and the great effect which the mind has upon the body, so that, whether from physical or mental causes, his life is occasionally protracted to one hundred years or more; and if we contemplate particularly the large size of the elephant, the great number of years requisite to enable him to acquire his full growth, and finally his maturity of two hundred years or more,—from all these circumstances we must be led to suppose, that the reptiles that have been found immured in sandstone and marble must have remained in that situation longer than we can reasonably attribute to the life of reptiles of any kind, and that the concretions (as some have supposed) that have assisted to enclose them, would be longer in forming than can be allowed for the usual term of their natural lives. Professor Buckland concludes, from his experiments, that when the natural organs of the animal are in continual action, the vitality of the toad has no extraordinary continuance, and that therefore life most terminate in a short time; but we are, on the contrary, led to believe that the vitality of the toad may be continued to an interminable length of time, provided the animal has become torpid by cold, so as to stop respiration and the circulation of the blood, and provided he remain at a low temperature, and without a free circulation of air, adapted to produce revivescence.

We may presume that the internal parts of the rock strata from which cold springs issue, are of about the same temperature as the water that issues from them; it may therefore be admitted as probable, that the toad, if enclosed in a rock, would not become quickened until after that rock has become warmer than the water that issues from it in summer; and that, under ordinary circumstances, the toad does not issue from his torpid state in the spring, until after the air becomes warmer than the spring water that issues from the rocks in summer.

That in every instance where toads are found immured in stone, there should be a crevice or aperture in the rock, to admit air and insects for food to the tenants, and that it has escaped the notice and

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* See Bakewell's Geology, page 21, note, first American edition, for a fact which gives a term of at least twenty five years to a toad imprisoned under the hollow of the bottom of a wine bottle, where he was annually inspected, and then was, through carelessness, permitted to make his escape.—*Ed.*

observation of the inquisitive observer, is contrary to all probability, especially as the occurrence has always excited the most intense curiosity, and more particularly as the opening must have been originally large enough to admit the body of the reptile.

I have been led to make the foregoing reflections, partly, from observing the custom of taking the large pike from frozen ponds and lakes in this country, and carrying them, in a frozen state, into other ponds, for the sake of propagating their species, where they appear to revive and to suffer no damage, except the loss of some of the scales; likewise, by seeing snakes that have apparently been frozen stiff, so that three or four inches of the tail have been broken off, like an icicle, and yet the snakes have revived, on being exposed to the warm air.

Toads are often ploughed up, early in the spring, when no signs of life appear, until after being exposed for some time to the warm air; these facts appear to bear on the case in hand, and I might add a number more of a similar character that have fallen under my observation.

No person is more willing to pay homage to the distinguished character of Professor Buckland than myself, or has a more exalted opinion of the great service he has done to science; but I cannot forbear (notwithstanding his deserved celebrity) to think that his experiments are very inadequate to settle the question of the long continued vitality of reptiles found in the different rock strata.

I was in hopes that some more able pen than mine would have discussed this subject in the Journal of Science, but as I find it is not yet noticed, I have ventured to give you a sketch of my ideas on this subject.

P. S. Not long since, as a number of laborers were digging a well in this town, and after penetrating five or six feet through the gravel, they came to the hard pan, and entering it about five feet more, they found a live toad about two thirds the size of a full grown toad. It was enclosed in a cell somewhat larger than the animal, but suited, in every way, to his shape. The discovery naturally occasioned much surprise, and they examined the surrounding materials and endeavored to put them into place, but they were so broken by the pick-axe, that they found it impossible to put them correctly together. The toad, on being exposed to the air, soon began to move, but died within the space of twenty or thirty minutes afterwards.

I have to remark that this well is situated on elevated ground, and that the hard pan, common in the United States, is composed of clay and gravel, cemented with iron, and is so firm that it cannot be broken up without a pick-axe and crow-bar, which are the implements commonly used by laborers in digging wells and cellars. It is to be observed, also, that the hard pan is free from fissures and seams, and equally impervious to air or water as the sandstone of the country. This reptile, beyond all doubt, was excluded from air and the means of acquiring food; below the effects of the warmth of the sun in summer, and below, also, that of the rain water that sinks into the earth, whereby it is warmed.

It appears to me that this instance furnishes a case, that is directly opposed to the inferences drawn by Prof. Buckland. In the absence of any direct evidence on the subject, he raises a presumption against the long continued vitality of toads; whereas, in all the accounts furnished in Europe and America, the evidence goes to prove, that the presumption he has made is opposed by well authenticated facts.

Art. V.—*Experiments for illustrating the causes of Water Spouts;* by Count Xavier DeMaistre.—Bib. Univer. Nov. 1832.

Translated by J. Griscom.

Among the explanations that have been given of water spouts, two only deserve attention; one which ascribes these phenomena to electricity, and another which, by imputing them to a circular motion of the air, considers them as dependent on causes purely mechanical. The celebrated Franklin adopted the latter theory; the former was supported by Brisson and Berthollon who sustained it by all the evidences of which it appears susceptible.

This system however does not explain the principal circumstances of the phenomenon. Electricity may furnish a pretty good account of descending spouts; we may conceive that clouds, strongly electric, may be attracted by the sea and descend to its surface, since they would offer no sensible resistance to the attractive force; but it is not so easy to explain how the clouds can attract and raise the water of the sea, and to determine the force which sustains in the air, a tall column of ascending fluid. Besides, water spouts have been observed when there were no apparent evidences of electricity.

Instead of attributing the formation of water spouts to this cause, it would be more natural to suppose that electricity, when manifested in their appearance, is developed by the motion of the air which occasions them.

But how shall we form an idea of this movement? How, from a cause of that nature, give a reason for two effects which appear opposed to each other, that of descending and ascending spouts. May we not, without confining ourselves to conjectures without proof, subject the phenomena to a certain extent, to experiment, and judge from analogy, of the nature of the movement which takes place in great whirlwinds, by that which we may observe in circular movements in other fluids, of small dimensions.

On the supposition that the motion of air alone in whirlwinds is sufficient to produce water spouts, the same motion in liquids ought to produce analogous effects, and if a whirling motion be excited in a light liquid placed on a heavier one, the latter ought to ascend in a spout into the former, as is the case in the natural phenomenon: this reasoning led me to the following experiments.

Fig. 1.

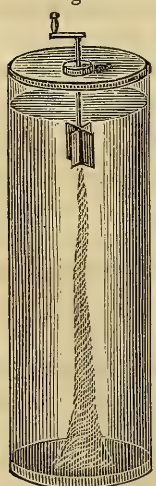


Fig. 2.

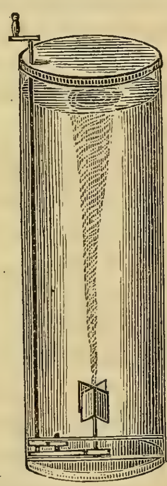
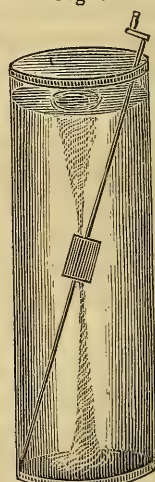


Fig. 3.



First Experiment.—Into a cylindrical vessel ten inches high and four in diameter I poured water to the depth of two inches and then filled up the vessel with very transparent poppy oil. At the surface of the oil I adjusted a little mill two inches high and an inch and a half wide, the axis being vertical and the branches, four in number, being entirely immersed in the liquid. I then caused the mill to revolve about twice in a second, and after continuing the motion for a minute, the water at the bottom began to whirl round and to rise a little in a conical form, and soon after, from the summit of the little cone a fine column of water sprung up all of a sudden, until it got into the vanes of the mill. (Fig. 1.)

This little water spout rising through the oil, was about two lines in diameter and resembled a tube of flexible glass; the water which it brought up into the mill was driven to the circumference of the whirl and descended afterwards in small drops with a narrow screw motion to the bottom, but so slowly that it was quite practicable to cause all the water to rise and mingle with the oil.

As the latter liquid easily loses its transparency by its mixture with the water and as it was nevertheless necessary to examine the motion of the whirl in all its parts, I instituted the following experiment.

Second Experiment.—I filled with pure water another vessel two feet high and nine inches in diameter, and threw into it an ounce of copal, coarsely pulverised; this substance having a specific gravity very little superior to that of water, remains a long time suspended, and yields to the slightest motion of the fluid which it renders visible. I adjusted the mill as in the last experiment.

When I commenced the experiment the coarser pieces of copal formed a layer at the bottom and the finer remained suspended. At the first turn of the mill, those in the direction of the axis ascended rapidly into the vanes, and those near the circumference took a spiral movement which carried them toward the bottom of the vessel. This whirling was propagated from layer to layer by means of these two motions, and when it had reached the particles at the bottom they rose, like the water in the first experiment but in a much thicker column, being from four to six lines in diameter, and ascended into the vanes of the mill, thus rendering the whirling spout very distinctly obvious.

To be able to follow a single isolated particle throughout its march, I threw in a few fragments of gum lac, which were easily distinguished by their red color. They were seen ascending rapidly in the center in the direction of a very elongated helix; the mill threw them to various distances according to their sizes and drove them in narrow spirals to the bottom, where they were brought again to the center to renew the same sport.

It is very remarkable that the little central column had a rotatory movement more rapid than the mill which produced it. The larger fragments of copal, as also drowned flies, were raised with difficulty and ascended more slowly, following a less elongated helix, which brought them within a short distance of the central column, around which they revolved like satellites.

When the spout had raised all the copal situated in the center of the bed at the bottom, the particles were observed to detach themselves by degrees from the circle, pass to the center to form the spout and thus the process went on until the bottom was quite cleared and the whole mass was in motion. In stopping the mill at this point, all the powder became deposited in the center in the form of a regular cone.

I varied the experiment by substituting smalt or the blue glass of cobalt of great fineness, and with the same result; the spout which was formed had the appearance of a blue silk cord, and was thinner by half than that of the copal.

The formation of the spout depends less upon the specific lightness of the powder than its fineness; with an equal movement, the pulverized smalt was raised more easily than the coarser copal. The diameter of the spout depends also upon the degree of coarseness of the particles of dust which form it, the blue glass produced a spout of three lines in diameter very regular, whilst in the same vessel and with the same mill, fine sand formed a spout an inch and a half in diameter; and what is very remarkable the last was interiorly empty and had the form of a tube, opaque on the borders, and transparent in the middle: in slackening and hastening by turns the movement, we see as it were clouds of very fine sand in agitation in the interior; in mixing this sand with pulverized smalt we distinguish two spouts one within the other, the exterior formed by a tube of sand and the interior by a column of blue glass less regular.

The cause of these various movements may be easily explained, if we observe that when the whirlwind is found on the surface of a liquid, the centrifugal force drives it toward the circumference and occasions a depression at the center; the equilibrium thus destroyed cannot reestablish itself but by the axis of the whirl, which is not subject to the centrifugal force: the liquid then rises in this part, pressed by the lateral columns which are higher, and being in its turn incessantly driven to the circumference, a constantly ascending current is established in the axis of the whirlwind.

It may then be regarded as a certain fact that an ascending current takes place along the axis of all whirlwinds, which are formed on the surface of liquids.

But this current would become descending if the whirl, instead of forming itself on the surface of the liquid, was excited at the bottom of the vessel, because in this case, the fluid driven by the centrifugal force could be replaced only at the superior extremity of the axis of the whirl; the following experiment will demonstrate this truth.

Third Experiment.—I adjusted the mill at the bottom of the vessel of water (Fig. 2.) and turned it by a mechanism which left it to act freely, as an inspection of the figure will show. There was soon formed a depression at the center of the surface of the water of the shape of a small funnel; and continuing the movements, the apex of the funnel or inverted cone of air which filled it, was perceived to extend itself by degrees, and approach the mill: bubbles of air were separated from this point, which descended rapidly to the bottom of the vessel; and at length when the rotary movement had acquired the ordinary velocity, a regular column of air extended throughout the axis and entered among the vanes of the mill occasioning a regular whistling sound.

This whirlwind was pointed below like a spindle, and the air divided into bubbles escaped from the mill and rose rapidly along the sides of the vessel. Light bodies, placed on the surface of the water, such as cork, and small bits of paper, after revolving within the gulf, were soon carried down to the bottom, whirling round with rapidity, as they descend, until they reach the mill, whence they rise along the sides. By regulating the movements, they may be retained at different depths as long as may be desired.

This experiment explains an extraordinary phenomenon which regularly occurs on the coast of Norway. "When the tide is rising," says Mr. De Buch, "the ebb and flow are compressed within narrow passages; the water turns in whirlpools the violence of which draws to the bottom boats which approach them; the unfortunate fishermen cling to their boats. Sometimes the whirlpool throws to a great distance both men and boats, but often they are swallowed up."*

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* Travels in Norway and Lapland, by M. De Buch.

This whirlpool, known in the country by the name of the gulf of Soltenstroem is a true spout of air in water, of which the foregoing experiment is a perfect representation on a small scale: and it may be considered as demonstrated that the gulf is produced by a whirlpool formed at the bottom of a narrow and deep canal in which the tide waters are compressed, while the surface is motionless; for in fact whatever rapidity may be given to a whirl at the surface of water, the depression at the center will not increase in proportion to the velocity, because the ascending central current continually replaces the fluid expelled to the circumference; but, when the rotation is given to the water at the bottom, the replacement can take effect only at the upper part of the axis, and of course the descending current must form a gulf at the surface.

On the same principle may be explained the fact that certain turns in rivers, are dangerous to swimmers, for though no actual whirlpool may be found at the surface, it is possible that a whirl at the bottom may occasion a descending current not sufficient to produce a sensible depression at the surface, yet rapid enough to affect the swimmer, whose feet are near the center of activity.

If in the last experiment the surface of the water be covered with oil, the specific gravity of which being but little less, the descending current may be produced by a much slower rotation. When it is first fairly formed, the surface of the oil preserves its level. The water precipitated at the centre draws in the thin stratum of oil which it touches, and to which it adheres with a force not inconsiderable.

When the surface of the oil begins to circulate, a depression is produced, and a whirl of air is formed in the center which, however, never descends to the bottom, whence it may be inferred that air has less adherence to oil than to water.

From the preceding facts, it is easy to perceive what must be the result when instead of being produced on the surface of the water, or at the bottom of the vessel, the whirl is found in the centre of the liquid column. Two opposite currents are then formed, one ascending and the other descending, which are carried along the axis to the centre of the primitive whirl.

Fourth Experiment.—I placed diagonally in the vessel a small glass rod, with the inferior end drawn to a point, and fastened it into a groove fixed to the circumference at the bottom; the other end was supported on the opposite edge of the vessel:

I had attached to the middle of the rod a parallelogram of varnished pasteboard. (Fig. 3.)

The vessel was filled with water to within two inches of the top. I placed at the bottom, a layer of blue glass, and on the water a layer of oil. The pasteboard, which was to form the whirl, was thus situated obliquely in the middle of the water, at an equal distance from the powder and the oil. I then turned the rod at the rate of about twice in a second, and it was not long before two spouts were formed; one ascending from the blue glass, the other descending from the oil, and uniting at the middle of the axis of the mill.

From the facts which have just been described, we see that the same mechanism, that is to say, the circular movement of a liquid, can alone produce ascending or descending spouts separately, or simultaneously, following the position of the whirl; the spout will be ascending if it is excited on the surface; it will be descending, if it is formed at the bottom of the vessel; and finally, a single whirl will produce an ascending spout, and another descending, if it is placed at the centre of the liquid column.

It is impossible not to see a striking analogy between the result of the experiments which have just been described, and the grand natural phenomena; in comparing them in the particular circumstances which accompany them, this analogy becomes evident, and must produce conviction. It results from the observations of travellers, that spouts always take place in a calm, or at most when only a light breeze is stirring, and that they are never observed during a great storm, which would seem at first more likely to produce them. The reason is, that the shock of winds, which produces the primitive whirl is always very far from the point where the spout begins to appear.

When we wish to raise a spout from the bottom of the vessel, we create a whirl at the surface of the liquid, and when we wish the spout to descend, we form a whirl at the bottom of the vessel.

In the natural phenomenon, the whirl which produces the ascending spout is formed in the clouds, or near the clouds, and extends by degrees towards the sea, favored by the inferior calm; if a rapid horizontal wind existed on the surface of the sea, the whirl in extending towards it, would be broken and scattered by the current. When ascending water spouts have a progressive movement, the elevated region of the atmosphere, where the whirl is commenced, must necessarily have the same velocity as the inferior part where the spout is produced; otherwise the latter would become oblique and would soon be destroyed; from the statements that are given, these spouts are sometimes broken, and instantly assume the aspect of a broken column. This arises from an increased velocity in the superior current, or in that of the inferior.

The phenomenon of an ascending spout in action, may be imagined as a vast column of air composed of two cylinders, one contained in the other, having a movement of rotation in the same direction, the inside one being very small, rises, while the exterior, which is much larger, descends. At the bottom of the column the exterior cylinder folds itself towards the centre in grazing the sea, and forms the interior cylinder, like a bag turned in at the bottom; the rapidity of the movement of the cylinders is in inverse proportion to their mass, and in direct proportion to the swiftness of the primitive whirl which produces the phenomenon.

When the whirl is fully established, it lasts as long as the winds which produced it in the clouds. It sustains itself—the air on the outside gives it no support, which explains the calm that exists at a short distance from the spout.

At the moment when, from the heights where it commenced, the whirl of invisible air, folding continually upon itself, grazes the surface of the sea; and drives the water from the circumference to the center, as the winds push the waves; then, it bubbles up, divides, and as it revolves, mixes itself with the air, forming a mixed spout of water and air, the weight of which is greatly inferior to a similar column of pure water. It must also be observed, that when the exterior part of the whirl reaches the sea in a spiral direction, it strikes the latter obliquely in pressing on the surface, which favors the adhesion of the two fluids, and causes the center of the air subjected to its operation to rise in the form of a cone. The truth of these observations is proved by the accounts given by different navigators.

Dr. Mercer, saw at Antigua, three spouts; the water was violently agitated in a circle of twenty rods, whence it was swept and carried into the air, with great rapidity and tumult.

It has been constantly remarked, that when the ascending spouts rise as high as the clouds, their density augments rapidly; they are seen accumulating, and growing darker, until the phenomenon ends in a tremendous fall of rain. This effect cannot be attributed to the water alone which rises from the sea. An ascending spout cannot take place from the sea to the clouds, without a corresponding descending current, from the regions of air above the cloud, which brings with it all the vapors that are above toward the centre of the primitive whirlwind.

Thus, in the fourth experiment, (Fig. 3.) the descending spout of oil, and the ascending one of blue dust, mingle in the zone which passes through the centre of the mill. In ascending spouts, below the clouds, the spectator can see only half the phenomenon, as the other half passes above the clouds; by this mechanism, the lowest parts of the atmosphere and those which are elevated above the clouds, are drawn to the same point by the two opposite interior currents of the spouts ; these strata of air, charged with vapour and often with a different kind of electricity, unite, and produce the thunder and other effects which sometimes accompany water spouts.

In descending spouts, the spectator sees the entire phenomenon, because the whirl which produces it, is formed between the clouds and the sea.

The water, under descending spouts, is generally seen to rise and boil, even while the aërial current is still far from the sea ; sometimes the two spouts join and form but one ; the primitive whirl is then at the point where they join ; but if they remain separate, it is because neither the one nor the other reaches the primitive and invisible whirlwind which produced them.

One circumstance in the 2d experiment presents another remarkable analogy ; it has been seen that sand produces an empty spout, into which clouds of fine sand are gradually forced ; similar observations of empty spouts have been several times made by travellers, who always represent them as opaque on the borders, and transparent in the middle.* In a description cited by Mr. Berthollon, se-

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* What is the force which retains the particles of sand and water in the regular circle in which they revolve as rapidly as if they had a centre of attraction ? The following explanation may, I think, be given, both as to the imitative experiment, or the natural phenomenon.

No portion of the surface can issue from the circle which it traverses without being replaced ; now the surface of the spout having throughout its height, the same circular movement, cannot remove itself from its axis, without occasioning a vacuum ; this surface is then retained by the pressure of the lateral columns.

The replacement cannot take place in the interior of the spout except at the inferior end of the axis, which is not submitted to the centrifugal force, and an equilibrium is there established, between the energies of the centrifugal force, and the weight of water withdrawn, and which determines the diameter of the spout.

This explanation applies also to the descending spouts ; it is known that they never have the regular and cylindrical form of the first, but rather that of a spindle or of a cone widening towards the clouds, and terminating in a point near the bottom. Here veral spouts appeared at their inferior extremities like tubes, through which clouds of smoke were seen to rise.

According as the particles which form the spout are heavier and larger, they have a greater breadth, and are formed into a tube; in one experiment a tube of sand was observed, containing in its interior a column of impalpable blue glass; in the case just cited, it is probable that the bottom of the spout was composed of drops of water, and that these formed the tube, into which a thinner vapour rose in visible clouds.

In the course of these experiments, in endeavoring to form spouts with sand, I remarked a circumstance which appears worthy of being stated.

When the column of water which rested on the sand, was not very high, and when a circular movement was given it, not only at the center, but throughout the mass, in turning it quickly with a rod, until the sand which is at the bottom of the vessel, is drawn in and mingled with the water, it settles, by deposition, at the bottom of the vessel in a cone as regular as if formed by the hand.

The ascending current has no longer force enough to raise the sand in a spout, though it has enough to collect it at the center. If the point of the cone is destroyed with a rod, it may be formed anew by gently circulating the water; the grains of sand are then seen to rise from the bottom on all sides of the little conical mountain, and by degrees to reestablish the point. May we not explain by a similar cause, the formation of those little conical mountains, which are so common in sandy plains, and in many places, where their regular

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the mechanism of the phenomenon is reversed; instead of drawing the water from below, the primitive whirl, which commences near the sea, draws the clouds from above, downwards, and as the clouds oppose less resistance than water to the interior current, which draws them, the spout is less pressed by the lateral columns of air; the centrifugal force must in consequence give it a greater diameter, especially near the clouds, where a replacement along the axis is more easy. Experiment 3d, Fig. 2, represented this effect very exactly.

An analogous mechanism is perceived in the currents of smoke which are sometimes produced by the firing of a cannon. The circular cylinder which forms them, revolves with such rapidity, that when it comes in contact with the trees, it visibly agitates the foliage; instead, however, of dispersing immediately, they retain their form for 15 or 20 seconds. In this phenomenon, the replacement of the portions of the surface, which have a tendency to remove from the centre of rotation, cannot exist anywhere, the cylinder being circular and continuous; the current must therefore subsist as long as the impulse which it received on leaving the gun continues.

form have caused them to be mistaken for ancient tombs, by supposing that they were formerly the center of a vortex of water?

It may be inferred from the preceding experiments and observations, that the cause of water spouts is purely mechanical, and that the movement of the air alone, is sufficient to produce them; but in discarding electricity, as the immediate cause of the phenomenon, it does not follow that it may not be a remote cause, since it is possible that this agent assists much in the formation of whirlwinds and of winds which produce them.

Art. VI.—*Observations on some Experiments in Electricity; by* Walter R. Johnson, Professor of Mechanics and Natural Philosophy in the Franklin Institute, Philadelphia.

1. *The electric spark.*

The appearance of the electrical spark, passing through air, has been observed with considerable attention by philosophers, and the various phenomena of its luminous track marked, with a reference to certain theories respecting the nature of the principle by which they are occasioned. The *brush* and the *star*, were formerly considered almost conclusive in favor of Franklin's hypothesis. The experiment of Cavallo and Singer, in which a pith ball laid in a non-conducting groove, is propelled towards the negative point of the discharger, has also been cited in favor of the same theory, as well as the direction of the flame of a taper placed between two balls oppositely charged, and that of the revolution of a light float wheel, acted upon by the electrical current. But since it has been discovered that some bodies have different conducting powers in reference to the two opposite electricities, or "*electrical states*," it has been doubted whether the above cited experiments afford any decisive indications in regard to the point in question.

There is, however, one interesting phenomenon which is not recollected to have been fully described by any writer on the subject.* It

* Some notice of the neutral point, has been taken by Berzelius, and a more distinct statement respecting it, is made by Dr. Thomson in his treatise on heat and electricity. The former in the 1st Vol. of his Chemistry, (Paris edit. p. 106,) maintains that "the *spark* is not a mere transmission of the electricity of an electrified body, to a conductor which it approaches. It is composed of the positive electricity of one of the bodies, and the negative electricity of the other, which unite and form an equilibrium at some point in the space which the spark seems to traverse. If the body which approaches the conductor, be uniformly rounded, the spark appears in the middle of the space between the two bodies. * * * At this point of *union*, the spark *snaps* and all the electrical phenomena cease." Thomson's language, (Lond. edit. p. 471,) is, "if the spark be very long, the middle part of it is not illuminated at all, or only very slightly. Now this imperfectly illuminated part, is obviously the spot where the two electricities unite, and it is in consequence of this union, that the light is so imperfect." Notwithstanding these authorities, (which were not consulted in regard to it, until long after my own observation had convinced me of the existence of the *neutral point*,) I have seldom found an electrician who was willing to believe in the existence of the said point until I had shown him the experiment.

consists of a dark spot occurring in the luminous track of the spark, when it passes between two balls or obtusely pointed rods. The longer the spark can be drawn, provided it pass in a single track, the more readily will the point of darkness (which, for distinction, we may term the *neutral point*) be detected by the eye. It will be found in different parts of the course, according to the relative magnitudes and other circumstances of the "positive" and "negative" balls, between which the spark passes. A commodious arrangement for exhibiting the phenomenon of the neutral point, is to insulate, on glass stands, two rods terminated with balls, and then making a connection of one with the prime conductor, and of the other with the rubber of the machine, to set the latter in motion, adjusting the distance of the two balls apart, to the power of the machine, state of the air, &c. so as to yield the longest possible sparks.

A rapid succession of sparks may thus be made to pass, and the neutral point will be the more readily perceived, the more nearly continuous is their repetition.

When one ball is much larger than the other, the dark spot is generally nearer to the larger ball.

The spark, if not more than three or four inches in length, will in general be perceived to traverse a path nearly direct, between the nearest points of the two balls; but not unfrequently the two luminous sections appear to meet after traversing the air in directions somewhat divergent from the straight line joining the centres of the balls. Here the neutral spot will be found. At other times, the two sections appear to follow lines, parallel to each other but not coincident, as if two streams were rushing in opposite directions and about to pass each other, when both are arrested and extinguished at the neutral point, without actually overlapping each other to any perceptible extent. It has probably been observed by others that the spark frequently assumes the aspect of a double cone of light, the base of each resting on one of the balls or other conducting bodies, and the two apexes united forming a variety of colors, blue, purple, &c. This appearance may occur when the balls are much nearer than the maximum striking distance.

2. *Method of detecting the course of currents in electrical discharges.*

In varying the experiment of the pith-ball, taper-flame, and float-wheel, the following method was found convenient, and in some respects highly satisfactory, as it served to show the influence of *magnitude* in the balls on the apparent direction of the currents of electricity. The rods of a Henley's discharger were employed to connect the *positive* and *negative* ends of the revolving machine. Between the balls was placed a card, suspended like a pendulum, with its faces to the two balls, and so confined as to prevent its revolving on the suspending rod as an axis, yet having a freedom of vibration, so as to carry its opposite faces successively into contact with the two balls. The suspending rod, as well as the two supports, were of glass. Both wires of the discharger were, as usual, pointed, but provided with balls of different sizes, with which the points could be covered at pleasure. On working the machine while the points were uncovered and the rubber insulated, but the collecting points in communication with the ground as well as with the rod of the discharger, it was found that the pendulum was propelled towards the positive or uninsulated point: on covering the negative wire with a ball one fourth of an inch in diameter, the card appeared to be undetermined in regard to its direction, but on substituting a ball half an inch in diameter, it was decidedly urged out of its vertical position towards the ball, and on using a still larger ball, of an inch in diameter, the card rose so high as to touch the ball and remain there as long as the machine was in action. On carrying the ball to the opposite wire and leaving the negative uncovered, the card moved still towards the ball. Larger balls had the effect of increasing the adhesion of the card. When a rapid succession of sparks was transmitted through the card, it was frequently observed to maintain a position nearly stationary between the poles, and this position was found to be the neutral point of the luminous track. A wire a few lines in length, sharpened at both ends and thrust through the paper so as to project on both sides, had the effect to transmit the currents with more steadiness; but the card was in each case moved the same distance as before from its vertical position.

3. *Flame of a candle between the poles.*

By placing a ball one inch in diameter on the positive pole, and exposing the naked point of the negative one to act upon the flame of a candle, the latter was impelled towards the ball and set fire to a slip of paper wound around it. This proves that the inference formerly deduced from an experiment with two balls, was made without a due regard to all its modifications. By turning the machine very rapidly, the flame was driven entirely away from that side of the wick which was opposite to the pointed (negative) wire and burned only on the side next the ball, reducing the flame to the thickness and height of the wick and about a quarter of an inch in breadth. In some instances the candle was actually extinguisned by the current.

4. *Length of sparks as affected by the size of balls.*

In making some experiments upon the length of sparks as dependent on the size of balls between which they passed, the following among other results were obtained.

Two conductors, in all respects alike and equally well insulated, furnished at one end of each, with a ball two and a half inches in diameter, and at the other end with one of six and a half inches, were placed, one in connexion with the rubber and the other with the collecting points, having the end of each which was farthest from the machine, brought into such proximity as to transmit the spark. When both the small balls were brought together, the spark they gave was 9.8 inches long, exhibiting a bright light for about an inch, near the negative ball, and a pale purple line through the rest of the course. On reversing the ends of the negative conductor, the other remaining as before, the length of the spark was not sensibly altered, but on bringing the six inch ball of the positive conductor near the negative one of the same size, the greatest striking distance was five and a half inches, and the same when the negative conductor was again reversed so as to send the spark between the two and a half *negative* and the six inch *positive* balls.

5. *The season most favorable to electrical experiments.*

It is a common opinion that electrical experiments cannot be successfully executed except in cold weather. But a little reflection will assure one that the action of electricity, so far as the state of the air is concerned, is dependent chiefly on the relation between the thermometric and the hygrometric states of the atmosphere; in other words, on the elevation of the *temperature* above the *dew-point*. Hence the direction to warm the machine and apparatus before we attempt experiments; to wipe the insulators with warm cloths, &c. It would be of little use to wipe moisture from a glass, if the article wiped were left of a temperature to condense moisture from the surrounding air. Hence too the utility of artificially heating the apartment in which we operate, as we thereby produce a *local atmosphere*, with a considerable range between its dew-point and its actual temperature. In this manner I have often succeeded in experiments on jars and batteries in a close room, while it was actualy raining without. But it must be understood that the success will depend on the absence of means to raise the dew-point of the heated apartment; otherwise, the warmer air will not long avail towards insulating the charges. I cannot at present state how near the two points above mentioned may approximate without entirely destroying the power of the machine to retain the electricity which it develops; but when they are only 6° or 7° Fahr. from each other, its action will be comparatively feeble. The effect of their approaching within that number of degrees, will, however, be found more injurious in summer than in winter, because the absolute quantity of water in a given bulk of air, at the dew-point of the former season, is much greater than is found at that of the latter.

From observations* made at Philadelphia during two years preceding the month of May, 1833, it appears that the mean temperature of the months of December, January, and February, is *at this place* 30¾°, while the mean dew-point, for the same months is 23¾°, or *seven* degrees below. The mean temperature in June, July, and August, is 72.17°, and the mean dew-point, 61.10°, or 11.7° below; so that there is a difference of more than 5° in the distance of these points from each other, in summer and in winter. But in order to know the degree of deterioration to which the action of a machine will be liable from the hygrometric state of the air, we ought perhaps to consider also the absolute quantity of moisture present at each season. Now, a cubic inch of air at 23¾° contains .00103359 of a grain of moisture, and the same bulk at 61.10° contains .00350707, gr. or the latter has nearly *three and a half times* as much as the former. It is probable, then, that if we were to make experiments in the *open air*, both in summer and in winter, the greater excess of temperature in the one, would about counterbalance the less moisture in the other; but, as we can generally employ an artificially heated apartment in winter, which personal comfort would preclude in summer, we more frequently operate at that season under favorable circumstances than in the warm portion of the year.

In the spring of the year while both the temperature and the dew-point are gradually rising,—but the former, of course, rising most rapidly,—the distance of the two is 12¼°; and in the three autumnal months, when the temperature is descending, and the dew-point consequently falling, but with less rapidity, the distance between them is only 8.54°. The mean temperature in the months of March, April, and May is 57.66°, and in September, October, and November, it is 55°. So that

* See Journal of the Franklin Institute, Vols. vii, viii, ix, and x.

with a dew-point in spring at 39.41°, we have an excess of temperature of 12¼°, whereas in autumn with a dew-point at 46.46°, we have a mean excess of only 8.54° ;—hence, both causes conspire in favor of spring and against the autumn. The mean quantity of moisture in the cubic inch of air in spring, is .00174764 while that in autumn is .00220070, or about twenty-five per cent. more moisture, and one-third less excess of temperature in the latter than in the former. If we suppose experiments to be made in winter in an apartment artificially heated to 70° while its dew-point remains at 23.25°, we shall have an excess of 46.25°, and as before, a quantity of moisture expressed by .00103359. If under these circumstances, the dryness could be maintained constant, electrical experiments might be performed with great satisfaction, but as lecture rooms are sometimes furnished with pneumatic cisterns, and other sources of vapor, as well as occupied by numerous classes, the dew-point rises, more or less rapidly, far above that of the surrounding air without. The truth of this statement may have often been perceived by persons who wear spectacles, on which the moisture was condensed as they entered, from a cold atmosphere, an apartment at a high temperature, crowded with company, or furnished with other sources of moisture. It may also have been observed that a machine will sometimes work well soon after a fire has been lighted, but will lose its power rapidly as the company before whom it was to be exhibited, come together, and further, that it will temporarily regain its activity by opening a door for a short time and admitting a supply of *dry* though *cold* air.

The substance of the foregoing remarks and calculations may be presented in a tabular form, exhibiting moreover the ratios for the several seasons between the moisture at the dew-points and the excess of temperature by which it is accompanied. The seasons are arranged in the order of the ratios, beginning with the least favorable.

Seasons.	Temperature.	Dew-point.	Excess of temp. over dew-point.	Moisture in a cubic inch of air at the dew-point, in grains Troy.	Ratio of the moisture to the excess of temp.
	°	°	°	grs.	
Summer, ...	72.17	61.10	11.07	.00350707	315
Autumn, ...	55.	46.46	8.54	.00220070	388
Winter, ...	30.75	23.75	7.00	.00103359	677
Spring, ...	51.66	39.41	12.25	.00174764	701
Artificial temperature of a room in winter,	70.00	23.75	46.25	.00103359	4170

Hence it appears that the spring months are most favorable to electrical operations conducted in an atmosphere not artificially heated; but that the winter season offers greater facilities than any other for gaining a temporary advantage by elevating the temperature of a close and dry apartment. Professor Hare's remarks, in the last No. of this Journal, on the facility of charging batteries in such an apartment, without a connexion with the "common reservoir," is entirely in accordance with my own observations and practice in that particular, nor is it of the least importance whether the battery be insulated or not, or whether its interior surface be charged from the rubber or from the collector, provided the source of the *interior* charge, be insulated, when the outside of the battery is not. Nor need we be under any apprehension that the more exposed situation of the positive charge, when *outside*, and its greater facility of passing through the air, will diminish the durability of the charge; for if the positive charge, when on the *inside* has a narrow passage by which to *get out*, so has it when on the *outside*, a narrow entrance by which to *get in;* and the latter course it *must take*, before the discharge can be effected,—as all will agree, whether they adopt the theory of one fluid or of two.

In accordance with the foregoing remarks, I have, during the present month, (July, 1833,) compared the action of a machine, when the dew-point and temperature were 30° apart, with its performance when they were but 5° from each other. In the former case the sparks were nine inches, and in the latter, scarcely one inch. The first experiment was performed on the 19th, when the horizon was partly overcast, (temperature 81°—dew-point 51°,) and the last on the 24th, when the sky was perfectly cloudless;—temperature 80°, and dew-point 75°. The moisture in a cubic inch of air on the 19th was .00254757 gr., and on the 24th it was .00537226 gr.

The following experiments illustrate several of the preceding observations.

1. July 25th, the temperature in the open air was 79°, and the dew-point 68½°. An apartment which had been closed for two or three days, was found at the temperature of 82°, and with a dew-point at 76°. The machine, (a four feet plate,) was set in motion, having a single pair of rubbers, and collectors on the opposite end of the diameter. The sparks were now one inch and two-tenths long. The quantity of moisture in a cubic inch of this air was .00553634 grains.

2. The windows were next opened to allow the vapor to escape and admit the cooler air. In fifteen minutes the temperature had fallen to 80° and the dew-point to 70°. At that moment the sparks were tried and found to be, at a *maximum*, four and a half inches long. Moisture per inch .00461639 gr.

3. On replacing the second pair of rubbers, and putting collectors at a quadrant's distance from each pair, the sparks were at once reduced in length to two and one-third inches, but their vividness and and the frequency of their passage, were more than doubled. The balls between which the sparks passed in all these three experiments were two and a half inches in diameter.

4. All *other* arrangements remaining the same as in the last experiment, the *balls* were now varied, by putting alternately on the positive and the negative pole a ball, eight-tenths of an inch in diameter, the two and a half inch ball remaining on the opposite pole. When the small ball was on the positive side, the spark was four and a half inches, and when on the negative, only one inch and two-tenths, in length.

5. A candle was placed between two balls of two and a half inches; the flame was, as usual, projected upon the *negative*,—a four and a half inch ball was put on the positive, and one of two-tenths of an inch on the negative pole; the flame was shortened and spread in both directions. A point terminated the negative pole, and a four and a half inch ball the positive, the flame was driven to the positive side of the wick, as before described, and finally *extinguished* by the force of the current.

During all these experiments, the sky was overspread with clouds, and some drops of rain occasionally descended.

6. *Perforations in a Quire of Paper.*

The mode in which several thicknesses of paper, subjected to the discharge of a battery, are found to be perforated, is perhaps one of the most singular mechanical results of electrical action. This experiment of Symmer, gives, as he observed, a continuous perforation, with the hole in each sheet, on one part of its periphery turned in one direction, and on the other, in the opposite; as if two needles or bodkins had passed through the whole quire, side by side, in opposite directions, and each had protruded the edge of the paper on that side of the aperture by which it passed.

Some authors have represented that the outer sheet next to the negative ball, would be found more extensively torn than that to which the positive should be applied.

This has not been verified by my experiments when the *balls were of equal size.* In performing the experiment on sixty sheets of letter paper, it was observed that several of the outer sheets on each side, were torn from the point of contact as a centre, in radiant lines about half an inch in length. But the separate points of paper did not *all*, on either side of the package, appear to be thrown *outwards.* On one side of the hole they seemed to have been dashed into the cavity, and on the other, were inclined upwards around the center. As the smallest of the perforations was about one-tenth of an inch in diameter, it was easy to distinguish that every sheet partook of the double protrusion described by Symmer. The courses of the opposing currents were not always found to be two parallel straight lines, but rather indicated a double spiral, like two strands of a cord.

7. *The Card between the two Poles.*

In repeating the experiment of Mr. Lullin upon a card covered with vermillion, and interposed between the two wires from a battery, so that one of the latter should touch each of its faces, the usual result was obtained, of forming a black streak upon the colored surface from the positive, to a point opposite to the negative wire, where a hole was perforated, with a burr protruded, on both sides of the paper. On varying the experiment according to the method of Tremery, by placing the card in vacuo, and using small wires for the two *poles,* similar perforations, ten or twelve in number and in a line, more than three quarters of an inch in length, were produced at a single discharge. This line occupied the whole distance between the positions of the two opposite wires. In other instances, the distance being increased to several inches, the perforations were less numerous, commonly no more than one or two, and were found at intermediate points between the two poles, but did not as sometimes represented, show any decided relation between the degree of exhaustion, and the distance from the negative wire. It is evident from these facts, that the point of rupture in vacuo is a matter dependent chiefly on the accidental weakness of the paper at one point more than at another. For if the card be strong, but not very wide, the electricity will sometimes take a circuit over the edge, instead of following the direct path and passing through the paper. This result may be prevented by rolling the card up in the form of a cylinder, and placing the two poles, one within and the other without the enclosure. It would indeed be far more extraordinary to find the perforation uniformly opposite to the positive pole in *vacuo*, than to the negative, when the experiment is made in air.

The facts above stated, taken in connexion with those discovered by M. Ermann respecting the unequal degree in which the two electricities are insulated by other substances besides air, (such as flame of alcohol and phosphorous, dry alkaline soap, and liquid sulphuric ether,) furnish a strong proof that the experiment of Lullin cannot be claimed as peculiarly favorable to the *uni-fluid* theory.

8. *The form and arrangement of machines.*

The advantage of different constructions for electrical machines was formerly discussed, by philosophers, and attempts have been made to explain the manner in which the plate and cylinder machines respectively operate, to produce results so different from each other. Some of these explanations, although hardly deserving the name, appear to be generally acquiesced in. It has been remarked that "the* plate machine furnishes a more abundant quantity of the electric fluid than that with the cylinder, and that if the two machines furnish sparks of the same length, the spark from the conductor of the plate machine is much more active and more pungent than the spark from the cylinder machine." This difference is accounted for by saying that "the plate is rubbed on both sides, and the electricity taken away by the collector from one only of those surfaces; whereas in the other kind of machines, the outer surface only of the cylinder is rubbed, and the electricity is received immediately by the collector." But to say nothing of the experiments of Mr. Nicholson which proved that rubbing both surfaces of the plate gained no more electricity than to confine the operation to one; we may, I think, satisfactorily account for the difference by considering that the diameter of the *plate* is usually much greater than that of the *cylinder* machine, whence the electricity developed on the glass, is carried by the former, much farther out of the *influence* of the rubber, than by the latter.

The intensity of the spark is accordingly increased in the same manner as that of an electrophorus plate is augmented by removing it farther and farther from the resinous electric on which it usually rests; and when the negative and positive points of the machine are

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* See Rees's Cyclopædia, article "*Electrical.*"

at the greatest possible distance,—that is at the whole length of the diameter,—from each other, the intensity is at a maximum. To prove this we have only to employ the common plate machine with four rubbers on which the *collectors* are placed at *two* opposite points on the circumference, each a quadrant from one pair of the rubbers. A machine thus arranged yields a very copious supply of electricity and will charge a battery with great rapidity, but owing to the proximity of the rubber to the collector, the charge is in some measure condensed,—the stratum of air between the two, serving a purpose analogous to that of the glass in the Leyden jar. If, however we remove the collecting points from their usual position, and also detach one pair of the rubbers and substitute a collector in their place, we shall discover, at once, a remarkable difference in the working of the machine, while it furnishes a far less rapid accumulation of electricity in a battery, the sparks will be greatly increased in intensity. By a change such as is here described, I have caused a machine, which was yielding sparks of only three inches, to extend them immediately to eight inches and eight-tenths in length, the conductors, balls, and insulators remaining, in both cases, the same.

9. *A method of producing rotation.*

The following experiment furnishes an illustration of continued rotary motion derived from electricity, different from that of *flies* with recurved points.

Near the lower edge of a vertical plate machine four feet in diameter, of which the rubbers are on a level with the axis, I place on an insulating stand, a sharp pointed pivot, to receive a brass wire, or needle, five inches long which may revolve freely in a horizontal plane, like a common compass needle. The wire is furnished with a hollow brass ball at each end, half an inch in diameter. This needle, of course revolves in a plane at right angles to that of the plate, and is placed so far only from the latter that the balls will not interfere with it when the two revolve simultaneously. For the purpose of this experiment the collecting points and prime conductor of the machine, ordinarily placed at the vertical points of its periphery, are removed. On turning the plate the needle with its balls begins at once either to revolve, or to oscillate through considerable arcs. In the latter case the oscillation is in a short time converted into a complete rotation, that soon increases in rapidity to two or three times a second, according to the action of the machine. Now if a fly-wheel or other revolving machine were substituted for the plate and its movement were sufficiently rapid, we might conceive that the air put in motion by friction, along its side, would produce revolution in any light system of bodies suspended near its vertical face. But then we should expect to find the revolution of the system coinciding in direction with that of the wheel, as if the wheel and revolving arms were connected by bevel gearing.

In the experiment above described the revolution is always in the opposite direction; that is, the ball nearest to the plate moves in such a manner as to *meet the motion* of the plate itself. If instead of two arms and balls we use four of each, at right angles, the result is the same, but the effect more immediate; the revolution takes place without the oscillations above mentioned. I have said that the supporting stand was insulated. But, the experiment succeeds equally well when the cap containing the point on which the needle rests is connected with the ground.

The explanation of this experiment appears to depend on the different degrees of intensity with which the plate acts upon the air at different distances from the rubber. As the glass in its revolution becomes gradually divested of its charge, the part opposite to a light body near the rubber, will be capable of furnishing to the air a greater portion than one more remote; and as air, when dry, appears to conduct electricity much in the same manner as liquids conduct heat, that is by means of its *mobility*—the currents caused near the machine will be more rapid where the accumulation is greatest, hence those balls and arms nearest to the rubber are most vigorously repelled. The currents become perceptible by the aid of a lighted taper held near the plate.

10. *Amalgam*.

In some experiments on coatings for the rubber, I have found plumbago reduced to an impalpable powder, to answer the purpose of an amalgam, nearly or quite as well as the compounds of zinc, tin, and mercury recommended by electricians. The plumbago should be free from silicious matter or other impurities which may scratch the glass.

Note. Throughout these observations the terms *positive* and *negative* have been employed, in conformity with common usage, rather than with the conviction of their strict propriety.

Art. VII.—*Botanical Communications;* by H. B. Croom.

I. *Floral Calendar of Middle Florida, during a portion of the year* 1833.

Observation.—By Middle Florida is understood that tract of country which lies between the Suwanee River on the east, and the Appalachicola on the west; but the neighborhood in which these observations were chiefly made lies about twenty miles west of Tallahassee, about thirty miles from the Gulf of Mexico, in latitude about 30° 30′, and is more tardy in its vegetation than the country lying east of Tallahassee. The country between the Suwanee and the St. John's is still warmer than that between the former river and the Appalachicola or the Escambia. The wild orange, so plentiful on the St. John's and in the Allachua, is unknown to the west of the Suwanee. At St. Augustine, the sweet orange is cultivated with success, but the attempts to raise it in the *interior* of Middle Florida have failed. On the sea coast and islands they might be successful.

1833.	*Abbreviations.*—b. for "in bloom." b. b. for "beginning to bloom." Ph. for Pursh. Nutt. Nuttall. El. Elliott.	Thermometer. 9 A. M.	3 P. M.
Jan. 1–5.	Heliotropium indicum b. (at Aspalaga.)	From 60 to 70.	
"	Rudbeckia hirta b. Pine woods.		
"	Houstonia rotundifolia b. Much diffused.		
"	Gentiana alba (White flowered Gentian) b. Wet pine woods.		
"	Gerardia (aphylla, Nutt.?) b.		
"	Some species of Aster in bloom.		
"	Eriogonum tomentosum b. Dry sandy soils.		
"	Some species of Chrysopsis in bloom.		
	Obs. Some of these flowers are to be considered as *occasional,* and not in their regular times of appearing.		
"	Some species of Viola begin to bloom.		
"	Nicotiana Tabacum (Tobacco) b. Occasional.		
6.	Helianthus annuus (sun-flower) b. Occasional.		75
"	Garden peas in bloom.		
	Obs. On the 9th rain occurred, and a violent change of weather ensued. On the morn-		

1833.		Thermometer. 9 A. M.	3 P. M.
	ing of the 11th the thermometer stood at 26° Fahr.; ice was formed, and garden peas killed. Destructive frosts have sometimes occurred in the spring, as, for instance, on the 6th of April, 1828, when, not only the growing crops of cotton, maize, &c. were killed, but many *hickory trees*, and some *persimmon trees* were killed by it, their foliage being, at that time, considerably expanded. Nevertheless, the culture of sea island cotton and of the sugar cane is successfully pursued.		
Jan. 14.	Weather balmy and delightful.	64	70
17.	Thermometer at sun-rise 32°; sleeted a little. On the 18th, ice. 19th. Beginning to moderate.		
20.	A peach tree and plumb tree on the Micosookee Lake had a few flowers.		
24.	Flower buds of Acer rubrum begin to appear on the Micosookee Lake.		
"	Flower buds of Prunus caroliniana begin to expand.		
22.	Trillium sessile b. b. Mitchella repens b.		
25.	Gelsemium nitidum (Carolina jessamine) b.		64
Feb. 8.	Vaccinium corymbosum (whortle-berry) b.	58	64
10.	Peach trees begin to bloom on Rocky Comfort.		
"	Senecio lobatus b. b. Plumb trees (P. domestica) b. b.		
11.	Acer rubrum (red maple) b. b.		70
13.	Corchorus b. in gardens.		74
14.	Viola villosa, V. lanceolata, V. cucullata and V. pedata b. b.	57	70
17.	Molucca raspberry b. b. Gardens.		78
18.	Cercis canadensis (red-bud tree) b. b.		80
19.	Vaccinium myrsinites b. b.		82
20.	Laurus geniculata b. b.		
21.	Iris (hexagona?) b. b. in gardens.	52	
22.	Azalea nudiflora (swamp honeysuckle) b. b.	54	

1833.		Thermometer. 9 A.M.	3 P.M.
Feb. 23.	Illicium floridanum (aniseed tree) b. b.	60	
"	Peach trees generally in full bloom.		
24.	Flowers of Cornus florida begin to expand.	60	
"	Quercus nigra and Q. falcata b. b.		
25.	Laurus Sassafras (sassafras tree) b. b.	36	54
"	Æsculus Pavia (buck's-eye) b. b.		
"	Aronia arbutifolia b. b.		
"	Sanguinaria canadensis (puccoon) b. b.		
26.	Rubus trivialis, El. (dew-berry) b. b.	48	60
27.	Fagus sylvatica, var. americana (beech tree) b. b.	60	80
"	Halesia tetraptera (snow-drop tree) b.		
"	Prunus caroliniana b.		
	Obs. This fine evergreen tree and also the Halesia diptera are abundant ou the banks of the Chattohochie.		
"	Caprifolium sempervirens (coral honeysuckle) b. b.		
"	Oxalis corniculata (sorrel) b.		
28.	Salvia lyrata (wild sage) b.	68	80
March 1.	First notes of the whip-poor-will (Caprimulgus.) Rain.	71	78
"	Pinguicula lutea b. Rosa lævigata (Cherokee rose) b. b. Gardens.		
2.	Olea americana (wild olive) b. Ice formed.	36	50
3.	Thermometer at sun-rise 32°. Ice formed.	36	56
4.	Frost in the morning.	44	60
7.	Mylocaryum ligustrinum b. Phlox (pilosa?) b.	68	76
8.	Chaptalia integrifolia b. Amaryllis Atamasco b.		
9.	Bignonia capreolata b. Ascyrum (crux Andræ?) b. b.	42	60
"	Hopea tinctoria (yellow-leaf) b.		
10.	Cornus florida (dog-wood) b.	52	72
11.	Pyrus angustifolia (wild crab) b.	60	72
15.	Began to plant sea island cotton. Pinus palustris b.	65	72
18.	Stipa avenacea b. Allium striatum, El. b. b.	65	72
19.	Batschia (Gmelini?) b. Sisyrinchium bermudianum b.		72

1833.		Thermometer. 9 A. M.	Thermometer. 3 P. M.
March 22.	Helonias angustifolia b. b.		73
25.	Calycanthus floridus b. b. Rubus villosus b. (Tall black-berry.)		
"	Magnolia auriculata b. b. Jatropha stimulosa b. b.		
23.	Chionanthus virginica (fringe tree) b.		
24.	Sagittaria natans b.		
"	Helianthemum carolinianum b. b.		
"	Lepidium virginicum (pepper-grass (b.)		
26.	Neottia (tortilis?) b. b. Ceanothus microphyllus b.	62	68
"	Baptisia lanceolata, El. b. b. Cratægus tomentosa b.		
27.	Salix nigra (willow) b. Gnaphalium purpureum b.	66	74
"	Antirrhinum canadense (snap-dragon) b.		
28.	Lupinus villosus b. b. Coreopsis lanceolata b. b.	70	78
29.	Quercus virens (live oak) b. Baptisia alba b. b.	48	52
30.	Silphium tomentosum, Ph. b. b. Multiflora rose b. b. Gardens.	51	62
31.	Malva caroliniana b. b. Vaccinium stamineum b.	52	58
April 1.	Kalmia latifolia b. b. Sanicula marylandica b. b.	52	72
"	Melia Azedarach (pride of China) b. b. Œnothera linearis b. b.		
"	Lupinus perennis b. b. Hypoxis graminea b.		
2.	Ilex opaca (holly) b. Iris versicolor b. Robinia Pseudacacia b. b.		
3.	Hymenopappus scabiosæus b. Erigeron (2 species) b.		
"	Leptopoda puberula, Nutt. and El.? b.		
5.	Styrax glabrum b. b. Pentstemon pubescens b. b. Verbena Aubletia b.		
"	Glycine frutescens, Willd. b. (Wisteria, Nutt.) Tradescantia virginica b.		
6.	Sida . . . . b. Hypericum parviflorum b.	70	76

1833.		Thermometer. 9 A. M.	9 P. M.
April 7.	Strawberries (Fragaria vesca) begin to ripen.	74	76
8.	Campanula amplexicaulis b. Pinguicula pumila b.	65	78
9.	Magnolia macrophylla b. b. (Large leaf magnolia.)	64	78
	Obs. This splendid little tree is found on the outer margin of the swamp of the Appalachicola River.		
"	Rhus radicans (poison vine) b. Viburnum prunifolium b.		
10.	Rhus toxicodendron b. Itea virginica b. Rosa parviflora b.	68	70
11.	Silene Baldwynii (Nutt.) b.	70	74
18.	Stuartia virginica b. b. Vaccinium arboreum b. b.		
20.	Bumelia tenax and B. reclinata b. Cynoglossum . . . . b.		
24.	Magnolia grandiflora b. b. Heliopsis lævis b.	74	84
25.	Hydrangea quercifolia b. b. Solanum nigrum b. b.	70	76
26.	Tetragonotheca helianthoïdes b. Glycine simplicifolia b.	72	84
27.	Asclepias variegata b. b. Aster . . . . b.	66	76
28.	Spigelia marylandica b. b. Scutellaria (integrifolia?) b.	68	78
29.	Decumaria sarmentosa b.	70	78
May 1.	Echites difformis b. Smilax peduncularis b.	68	80
2.	Argemone * georgiana b. b. in gardens.	68	82
	Obs. This is the white flowered Argemone mentioned by Nuttall and Elliott. It is probably a distinct species from A. mexicana. Its petals are usually eight, white; capsules five to six celled.		
3.	Ceanothus americana b. b. Delphinium azureum b.	73	85
4.	Prenanthes aphylla, Nutt. b. b. Physalis . b.	72	82
5.	Castanea pumila (chinquapin) b. b. Veratrum luteum b.	72	82

1833.		Thermometer. 9 A.M.	3 P.M.
May 6.	Porcelia pygmæa b. b. Delphinium consolida (larkspur.)	71	80
7.	Sambucus canadensis (elder) b. b. Rain.	71	78
8.	Phytolacca decandra (poke) b. Rhus vernix (poison sumach) b.	70	76
9.	Aletris farinosa (star-grass) b. b. Ruellia strepens b. Rain.	72	76
10.	Polygala incarnata b. b. Jasminum officinale. Gardens. Rain.	74	76
"	Asclepias tuberosa b. b. Apocynum pubescens b. b. Rain.		
11.	Erythryna herbacea (coral tree) b. b. Galardia bicolor b.	72	76
12.	Magnolia glauca (white bay) b. b. Rain.	72	76
13.	Laurus carolinensis (red bay) b. b. Papaver somniferum b. b. Rain.	72	76
14.	Andromeda arborea (sour-wood) b. Passiflora incarnata b. Rain.	72	76
15.	Hydrangea hortensis b. b. Catalpa cordifolia (Catawba tree) b.	72	82

June 6th, 1832. Short-staple Mexican cotton (Gossypium hirsutum?) began to bloom.

II. *Account of some new species of Plants.*

1. *Baptisia* * *simplicifolia.*

Plant about two feet high, herbaceous, glabrous; stem geniculate, branching; stipules none? ; leaves *simple*, alternate, sessile, ovate, glabrous, about two inches and a half long, one inch and a half wide; racemes terminal, long; legumes small. The flowers I have not seen. Grows near Quincy, in Middle Florida, along with Baptisia lanceolata, El. Flowers June, July.

2. *Amorpha* * *caroliniana.*

Plant shrubby, four to five feet high; branches pubescent, striate; leaves pinnate; leaflets oblong, obtuse, mucronate, petiolate, covered on both surfaces with minute, shining hairs, and thickly studded with diaphanous glands; spikes *solitary*, *short;* flowers very small, dark purple, approaching to indigo; calyx sprinkled with minute hairs. Found by Dr. Loomis in 1832, near Newbern, flowering in July.

3. *Thyrsanthus* * *floridana.* (Wisteria, *Nutt.* Apios, *Ph.* Glycine, *Willd.*)

A specimen which I hastily gathered in Florida, appeared to belong to an undescribed species of the Thyrsanthus of Elliott, (the Wisteria of Nuttall,) perhaps the species referred to by Mr. N. II. 116. In this specimen the *upper lip* of the *calyx*, instead of being "truncate and emarginate," was rounded and entire! the three equal divisions of the lower lip shorter and less acuminate than in Thyrsanthus frutescens, El. (Wisteria speciosa, Nutt.) Plant shrubby and twining, leaflets about 6 pair and an odd one, flowers perhaps a little paler, but in its whole habit strikingly resembling the "Carolina Kidney-bean," which has received from botanists such a host of names.

4. *Sarracenia* * *pulchella.*

Leaves three to four inches long, decumbent, purple, spotted nearly all over with white; dorsal wing broad, lanceolate; appendix nearly closing the tube, and shaped like the head of a parrot! Grows in the wet pine-barrens of Florida. Flowers in April. I am informed that Mr. Nuttall had previously discovered this plant, and considered it a new species. Scape about eight inches high, flowers purple.

5. *Argemone* * *georgiana.* (White flowered Argemone.) See Nutt. and Ell.

Petals usually eight, sometimes seven, white; capsules 5—6 valved. Flowers in May.

III. *New Localities of Plants.*

1. *Dionæà muscipula.* (Venus's Fly-trap.)

When Mr. Nuttall published his "Genera of North American Plants," (1818) this curious and wonderful plant was only known to botanists as growing in the neighborhood of Wilmington, N. C. on the north side of the Cape Fear river. Mr. N. traced it thence for fifty miles above. I first saw it in Bladen County, on Black river, a tributary of the Cape Fear. Two years ago, Dr. Loomis and myself found it in the neighborhood of Newbern, on both sides of Neuse river. Recently, in passing through the county of Duplin, N. C. I found it flowering, and in great abundance, in the wet pine-barrens of that county, associated with Sarracenia flava, and Liatris odoratissima. I am informed that it grows in Onslow County, intermediate between Newbern and Wilmington. Flowers early in June.

2. *Macbridea pulchra*, El.

Found by me in Lenoir County, N. C. flowering in August.

3. *Pinus pungens*. (Table Mountain Pine.)

Grows on the elevated and rocky summit of the Pilot mountain, Stokes County, N. C. Hitherto found only on the Table Mountain, and "other summits of the Catawba Ridge." See Michaux and Nuttall.

4. *Magnolia macrophylla*. (Large leaf Magnolia.)

Grows in Florida, on the outer margin of the swamp of the Apalachicola river. The petals of some of the flowers measured seven inches in length, while those of M. grandiflora measured six inches. I am informed that it grows in the upper parts of Georgia and Alabama. Its original region is probably sub-alpine, and the plants that grow in Florida may have sprung from seeds carried down by the freshets of the Chattohochie. In like manner the *Pecan trees*, (Juglans olivæformis) which I saw on the banks of the Mississippi, thirty miles below New Orleans, were probably brought by the freshets from their native climates on the Illinois and the Ohio. Flowers in April.

5. *Penstemon dissectum*, El.

Abundant in wet Pine woods, between the Oakmulgee and Oconee rivers, Georgia. Flowers in May.

6. *Prenanthes aphylla*, Nutt.

In Florida, and the southern parts of Georgia. Flowers in May.

7. *Andromeda speciosa*, var. *pulverulenta*.

Abundant in wet places, from Fayetteville, N. C. to the Pedee river. Flowers in May, June.

8. *Ledum buxifolium*.

Found by Dr. Loomis, seven miles south of Fayetteville, N. C.

9. *Peucedanum ternatum*.

Found by Mr. Nuttall, near Newbern, N. C. in 1832.

10. *Orontium aquaticum*.

Grows in the lagoons of the Ocklockony river, Florida, fifteen to twenty miles *above the tides*. Flowers in April.

11. *Galax rotundifolia*. (aphylla, Nutt.)

Grows near Newbern, N. C.

12. *Cypripedium humile*.

Found, though rarely, near Newbern, N. C.

13. *Galardia bicolor.*
From Florida to North Carolina. Abundant near Fayetteville, N. C. Flowers May—June.

14. *Prunella vulgaris.*
I traced this plant from Florida to Newbern. It is decidedly indigenous. Flowers May, June, and July.

15. *Erythrina herbacea.* (Coral tree.)
This elegant plant, which is rare in Carolina and Georgia, is abundant in Middle Florida. Flowers in May.

IV. *Specimen of a Comparative Flora.*

Names of Plants.	Middle Florida.	Newbern, N. C.	Maryland. Valley of the Patapsco.	Pennsylvania.	Maine.
Cornus florida, (Dog-wood.)	March 10.	April 10.			
Melia Azedarach, (Pride of China.)	April 1.	May 1.			
Laurus carolinensis.	May 13.	June 10.			
Ilex opaca, (Holly.)	April 1.	April 25.			
Stuartia virginica.	April 20.	May 20.			
Chionanthus virginica.	March 25.	April 20.	May 25.		
Kalmia latifolia.	April 1.		June 1.		
Robinia Pseudacacia.	April 1.			June 1.	
Magnolia macrophylla.	April 12.			June 15. Bartram's Garden.	
Peach tree, (Amygdalus persica.)	Feb. 12.		April 9. Baltimore.	April 15. Philadelphia.	May 15. Brunswick.
Upland Cotton.	June 4.	July 2.			
Acer rubrum, (Red Maple.)	Feb. 11.			April 7.	

See American Journal of Science Vol. I. *p.* 76.

Note.—From the above it would appear, that the difference in the season in Middle Florida and in Maine, is about *three months;* in the former, and at Philadelphia, *two months,* &c. The whole difference of latitude thus compared is nearly 14 degrees, and the progress of vegetation, I think, may be considered about 5 degrees in a month.

Phenomenon in vegetable life.—Near Quincy, in Middle Florida, the following fact has been witnessed by myself, in common with many others: Two Pine trees (Pinus palustris,) of considerable height growing near each other, the trunk of one of them, near its upper extremity, coming in contact with a limb of the other, they *grew together*. Subsequently, the former became severed near the earth, by burning, apparently. The tree, thus severed and *suspended*, continues to live! deriving its sustenance entirely from the fluids of the the other tree—a remarkable parasitic!

Art. VIII.—*A description of a new Mineral Species, from Nova Scotia;* by C. T. Jackson, M. D., *with a Chemical Analysis;* by Mr. A. A. Hayes, of the Roxbury Laboratory.

Read before the Boston Natural History Society, July 7th, 1833.

During the summer of 1827, Mr. F. Alger and myself made a Mineralogical and Geological Survey of the peninsula of Nova Scotia, an account of which was published in the American Journal of Science, Vols. xiv. xv. While on this survey, we collected a great number of minerals, principally of the zeolitic family—among which we observed several groups of crystals, having the lustre and general appearance of analcime, but incompatible with that species, in their crystalline form. On our return to Boston, I examined, more particularly, the external and chemical characters of this mineral, and showed it to my friend Mr. Nuttall, who requested me to let him take the specimen with him to London, where he showed it to Mr. Brooke, who measured the angles of the crystal with the reflective goniometer, and expressed his opinion that it was phosphate of lime.

On Mr. N's return to this country, he told me of Mr. Brooke's decision. I mentioned to him the manner in which the mineral comported itself with tests, and before the blow-pipe flame, which proved that Mr. Brooke was led into error by taking one set of characters only. A few crystals were now sent to Dr. Torrey, of New-York, by Mr. N. requesting his opinion of them. A short time after which Dr. Torrey published a note in the American Journal of Science, stating his belief that the mineral was Nepheline.

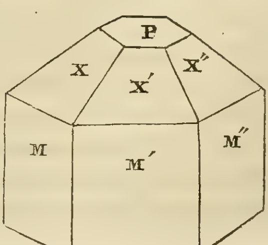
While in Paris, I gave a few crystals to Mr. Dufrenoy, of the school of mines, requesting him to measure them with the reflective goniometer, and to give me the result of his examination. I received a note, a short time afterwards, giving me some of the angles which he compared with those of phosphate of lime, in Haüy's Mineralogy, Pl. xxx. Fig. 72, from which he found them to differ in value. Mr. Clemson, of the School of Mines, wishing to analyze the mineral, I gave him all the remaining crystals of the stock I carried out with me. His analysis, however, was interrupted by an accident that happened in the laboratory of the school, and the specimen was lost. Being satisfied, from the examination I had made of this mineral, that it was new, and not having time to analyze it myself, I furnished Mr. Hayes with all the crystals I could spare from my specimens, to which Mr. Alger added some obtained from Mr. Nuttall. Mr. Hayes has at length completed his analysis, which he now presents to the public. This accomplished chemist is too well known to the scientific world to require any praise from me.

The mineral under consideration was found at Cape Blomidon, in Nova Scotia, beneath a precipice of basaltic rocks, from which it had recently fallen, with a large vein of stilbite, mesotype, and analcime. The crystals are generally implanted in the analcime or stilbite. Some of them are colorless, transparent, and extremely brilliant; others are of a salmon red color, and translucent only.—The color being irregularly disseminated, it is evidently accidental. Its hardness is nearly the same as that of felspar, which it scratches with difficulty, being itself powdered by the friction. Specific gravity, as determined by Mr. Hayes=2.169. The crystals have generally the form of low six-sided prisms, terminated at each extremity, by six-sided pyramids, which are replaced, at their summits, by little hexahedral tables. Some of the crystals have transverse striæ on the sides of the prism, which I at first thought indicated a rhomboid for the primary form. But the plane terminations indicate a six-sided prism, which, from the direction of the natural joints, made visible by heating the crystal, seems to be its primary form.

I have not succeeded in obtaining the nucleus by cleavage, the mineral breaking with a vitreous fracture in all directions, from the intimate connexion of its particles.

The angles of this mineral, as determined by myself with the common goniometer, are

M on M′ or M″	120°
M on X	130°
M on P	90°



According to M. Dufrenoy, by the reflective goniometer, the angles are

M on X 130° 5′ or 130° 10′
X on X′ 142° 10′

In the second edition of our memoir on the Mineralogy and Geology of Nova Scotia, we compared this mineral with the Davina of Monticelli and Covelli, which we had not then seen. It differs very obviously from this mineral, in external, as well as chemical characters, and composition.

The following is the composition of Davina, which the reader may compare with the results of Mr. Hayes's analysis of our new mineral.

Davina.		Ledererite.	
Silica,	42.91	Silica,	49.470
Alumina,	33.28	Alumina,	21.480
Lime,	12.02	Lime,	11.480
Oxide of Iron,	1.25	Soda,	3.940
Water,	7.43	Phosphoric acid,	3.480
Loss,	3.11	Oxide of Iron,	.140
		Foreign matter,	.030
		Water,	8.580
		Loss,	1.400

We propose for this mineral, the name of *Ledererite*, in honor of the Austrian ambassador to the United States, Baron Lewis Von Lederer, who has done so much, by his zeal in this department of natural history, to encourage and facilitate its study.

Analysis of the Ledererite; by Mr. A. A. Hayes of the Roxbury Laboratory.

The Ledererite presents the following characters.

When heated in a small mattrass, it becomes white and opake and gives off water, free from acid, or alkali; a slight empyreumatic odor is perceptible.

In the forceps, before the blowpipe flame, it becomes white and divides at the natural joints; at a higher temperature it fuses into a white enamel, which can be rendered more vitreous by continuing the blast; a few bubbles are disengaged when it is thus treated.

On a platina wire, with its bulk of soda, a fragment fuses, with effervescence, into a white enamel, which is unaltered by exposure to the reducing flame; more of the mineral fuses with the enamel into a colorless transparent globule; excess of soda does not render the globule infusible, or indicate manganese.

Borax dissolves its bulk of the mineral and gives a colorless glass, which in the reducing flame, becomes more dense. If an equal bulk of the mineral is added to the globule, it can be dissolved by long exposure.

By Phos. Ammo. and Soda, when the fragment is equal to the size of the globule of salt, it is quickly penetrated and it then fuses and affords an opaline globule; in the reducing flame the globule is transparent whilst hot, and becomes translucent on cooling. By an intermitting flame the globule becomes opake.

Boracic acid, on charcoal, slowly dissolves the mineral; when the colorless glass is in contact with metallic iron, no phosphuret is formed; if oxide of iron is added, it renders the mixture more fusible, but we cannot detect any phosphoric acid in this way.

With nitrate of cobalt, there are the usual indications of alumina.

The mineral in coarse powder was washed in pure water, dried at 60° F. reduced to a fine powder in a mortar of agate and the hygrometric water was removed by exposure to dry air at 100° to 120° F.

I. Seven parts of the fine powder which had been cooled in a desiccated atmosphere, were heated till red hot, the loss was .60 and the color became a shade darker=4.29 water on 50 parts.

II. Fifty parts of the unheated mineral were mixed with strong and pure muriatic acid, no gaseous matter escaped; the temperature being about 80° F. decomposition had taken place after thirty six hours had elapsed. The excess of acid was in part removed by dry air at 120° F. the mixture was then diluted with water and filtered through a double prepared filter, the white powder which was left was carefully washed and ignited with the upper filter, cooled in a close vessel of dry air, its weight was 24.68; ashes of lower filter .05 leaving 24.63. This powder readily dissolved in a warm diluted solution of potash except .015 which was a light red powder, like that of the associated mineral; the alkaline solution was mixed with an excess of muriatic acid and evaporated, a dry mass was left, this moistened with strong muriatic acid, digested in water, the solution when clear gave with ammonia an extremely light flock of silica. If from 24.63, we take .015 there remains 24.615 pure silica.

III. The fluid of II. was nearly neutralized by pure ammonia; warmed till air was expelled; when cold, a slight excess of pure ammonia was added, the opaline fluid was then poured on a porous filter, covered by a bell resting on moist hydrate of lime, to prevent the absorption of carbonic acid. After draining, the bulky hydrate was washed in hot pure water, transferred to a dilute solution of pure potash, and boiled in it: a portion B. remained insoluble, after treating it with more potash, this being separated, the clear solution was evaporated and heated till a dry salt remained; muriatic acid and water then dissolved all but pure white silica weighing after ignition .12. The acid fluid was mixed with ammonia and carbonate of ammonia, the latter being in excess; the fluid was allowed to rest on the precipitate twenty four hours, it was then separated by a double prepared filter from the colorless hydrate; the latter being washed, was dried and ignited, till it suffered no further loss by heating; its true weight was 10.74. It was soluble in fused bi-sulphate of soda; after expelling the excess of acid, dissolving the salt and testing the solution, no trace of phosphoric acid remained; before the blowpipe it appeared as pure alumina. The solution of carbonate of ammonia and muriate of potash in which the alumina had been digested, contained no earthy matter, or phosphoric acid.

IV. That fluid which had drained from the first precipitate in III. had been secluded from carbonic acid, it was clear and slightly alkaline, a distilled solution of carbonate of ammonia being added, at first did not produce a change, after a few minutes a granular precipitate C. resembling carbonate of lime fell, leaving a transparent solution above it. After separating the powder from the fluid by a double filter and drying, it was weighed, then heated red hot, cooled and again weighed, it had suffered no loss, after the usual reductions 8.08 parts were obtained. Boiled in sulphuric acid till part was evaporated, treated with much alcohol, there remained a quantity of sulphate of lime equivalent to 8.08 of carbonate of lime and no trace of phosphoric acid was present in the alcoholic fluid, it was therefore pure and is equal to 4.55 lime.

V. The precipitate B. of III. which was insoluble in potash was washed into diluted muriatic acid, it slowly dissolved with the characters of a non-alkaline oxide, giving a yellow colored solution, which could not be rendered neutral without precipitation taking place. Much muriate of ammonia being added, a slight excess of caustic ammonia was dropped in and the matter which separated was collected on a double filter, when dried it became opake and after ignition and reduction its weight was 2.01. It appeared as a yellowish white powder, soluble in muriatic acid, its solution affording by evaporation small transparent crystals ; when these crystals were heated in sulphuric acid, a solution was obtained, in which crystals of sulphate of potash, caused the precipitation of delicate flocks of crystals of sulphate of lime. The crystals mixed with boracic acid and metallic iron, heated before the blowpipe flame, readily fused, and gave a globule of phosphuret of iron, it was therefore principally phosphate of lime.

VI. When the liquor and washings from the phosphate of lime in V. were united and evaporated, a mass remained, which when heated in a platina crucible, was volatilized except a half fused saline matter, enveloping a light white earth ; water digested for some time on this, dissolved all but a few parts ; the solution was saturated although considerable in quantity ; when partially evaporated it deposited imperfect crystals of a difficultly soluble salt, along with opake, soluble cubes. The mixed salt being dissolved in water, a trifling excess of carbonate of soda was added, the whole evaporated and heated, water then dissolved the soluble part, and the solution by evaporation deposited pure, well formed cubes of chloride of sodium, which when dried, weighed 3.713. This salt dissolved in water was not affected by a solution of chloride of sodium and platina or oxychlorate of soda, when the solution was evaporated with phosphate of soda, no insoluble matter remained ; thus proved to be free from potash, or lithia ; the chloride is equivalent to 1.97 parts of soda.

VII. That part which water did not dissolve with the portion left by carbonate of soda in VI. was united to the phosphate of lime of V. the whole weight was 3.00 parts, by digesting with sulphuric acid, evaporating to a paste and adding alcohol in a relatively large quantity, 2.94 parts of dry sulphate of lime were obtained. It was yellow colored and by subsequent treatment with oxalic acid and alcohol .07 per oxide of iron was separated, leaving 2.87 parts sulphate equal to 1.19 lime.

VIII. When the alcoholic solution from the sulphate of lime in VII. was evaporated and heated, it gave a glacial acid, very soluble in water and alcohol, its alcoholic solution burnt with a yellow flame. With oxide of iron, boracic acid and metallic iron, it gave by heating, phosphuret of iron ; it was phosphoric acid containing a trace of lime, and by difference its weight was 1.74.

The quantities of earth and acids into which this mineral has been decomposed, are

Silica, Process II. and III. - - -	24.735
Alumina, III. - - - -	10.740
Lime, IV. 4.55 VII. 1.19= - - -	5.740
Soda, VI. - - - -	1.970
Phosphoric acid, VIII. - - -	1.740
Oxide of Iron, VII - - - -	.070
Foreign matter, II. - - -	.015
Water, I. - - - - -	4.290
	49.300
Loss, partly water and phosphate of Lime. -	.700
	50.000

Or considered as a saline compound, its composition would be, in 50 parts, as analytically determined,

Bisilicate of Alumina, - -	30.040
Bisilicate of Lime, - - -	9.430
Subsilicate of Soda, - - -	2.485
Phosphate of Lime, - - -	2.970
Oxide of Iron, aud Foreign Matter, -	.085
Water, - - - - -	4.290
	49.300

The loss renders it necessary to express the soda salt as a subsilicate, but it probably exists as a silicate in the mineral. It is not known that the weight of water is determined with perfect accuracy. So small a quantity of the specimen was given me that I could not make any preliminary trials, or check the results by other processes.

Art. IX.—*Internal Improvements of the State of Pennsylvania;* by Edward Miller, Civil Engineer.

It is generally known to the readers of the Journal of Science, that the state of Pennsylvania has been, for several years, engaged in a system of Internal Improvements, of great extent and importance, but probably, only few of them are acquainted with the character of those improvements, and the difficulties which have been already surmounted in their execution. The object of the present essay, is to give a general idea of the character of these works, and in future numbers, it may be in my power to describe with greater particularity, those with which I am most familiar.

To a cursory observer of the map of Pennsylvania, it would appear almost impracticable to form any satisfactory junction between the eastern and western waters. The Allegany mountain, and the numerous ridges which run parallel to it, from N. E. to S. W. appear to interpose insuperable barriers. Fortunately, however, nature has done what man must have failed to accomplish. The headlong Juniata has burst through a score of mountain ridges, and, now flows placidly to the Susquehannah, as if rejoicing in its triumph over the difficulties, which at some former day had been heaped in its path. The West branch of the Susquehannah also rivals the Juniata, and in fact rises still farther west, (beyond even the Allegany mountains,) and there are swamps in the highlands of Cambria county which, in time of rain, pour their waters at once towards the Chesapeake and Gulf of Mexico.*

The course of the West Branch is however too circuitous to afford an eligible route between Philadelphia and the head of the Ohio, and the valley of the Juniata was chosen, although it involved the nenecessity of crossing the Alleghany, at a point 2327 feet above tide water in the Atlantic.

The only mountain ridges, west of the Alleghany, are the Laurel Hill, and Chesnut Ridge, both of which are rent to afford a passage for the Conemaugh, which rises in the Allegany mountains nearly opposite to the Juniata, and flows toward the Ohio.

Previously to the commencement of the state improvements, charters had been granted to the Schuylkill and Union Canal Companies, for opening a canal communication between the Delaware and Susquehannah, and as no canal route was found more eligible than that adopted by the companies, a rail-road between those rivers was chosen by the state.

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* Potter county, in Pennsylvania, is celebrated for only one thing, that I am acquainted with: viz. that heads of the Susquehannah, Alleghany, and Genessee rivers, rise almost together, within its boundaries; flowing into such distant points, as the Chesapeake bay, Gulf of Mexico, and Gulf of St. Lawrence.

The first appropriation for the Pennsylvania canals was made February 25th, 1826. The first contracts are dated June 1826, and the first ground was broken July 4th of the same year.

The works are distinguished by the names, Main line and Branches. The chain connecting Philadelphia with Pittsburg, is dignified by the first title; the Branches are those canals diverging from the main trunk up the Delaware, Susquehannah, North Branch, West Branch, Beaver and French creek.

THE MAIN LINE, commences in the heart of Philadelphia, by a rail-road, which crosses the Shcuylkill five miles above the City, and runs westward, through the counties of Philadelphia, Montgomery, Delaware, Chester and Lancaster, to Columbia on the Susquehannah river, a distance of eighty-one miles and three quarters. At this place the canal begins, and proceeds north west along the river, to Duncan's Island, at the mouth of the Juniata, where the Susquehannah is crossed by a towing path bridge, and the canal extends up the valley of the Juniata river to Hollidaysburg, one hundred and seventy-two miles, through the counties of Lancaster, Dauphin, Perry, Juniata, Mifflin and Huntingdon. At Hollidaysburg, the canal joins the Alleghany Portage Rail Road, which crosses the Alleghany mountains at Blair's Gap, and meeting the Little Conemaugh, follows it to its junction with Stony creek in Johnstown or Conemaugh; having crossed portions of Huntingdon, Bedford and Cambria counties. The length of the Portage is thirty-six miles and two-thirds. At Johnstown, the canal again commences, and pursues the vallies of the Conemaugh and Kiskiminitas rivers to the mouth of the latter, then crossing the Alleghany river on an aqueduct, it keeps on the western bank to Pittsburg, where it re-crosses in a similar manner, and passing through Grant's Hill, by a tunnel, debouches into the Monongahela, one hundred and four miles from Johnstown, having cut through Cambria, Indiana, Westmoreland, Armstrong, Butler, and Alleghany counties.

The whole length of the main line is three hundred and ninety-five miles, of which two hundred and seventy-six are canals, and one hundred and nineteen, rail roads. Exclusive of all side cuts and branches, the canals overcome 1178 feet of ascent and descent, and the rail roads, 3416 feet. Total 4594 feet.

The annexed table may be useful in a topographical point of view, and was drawn up by me from authentic sources. It shows the height of the most important places on the main line above tide, and the differences in level between them. It also gives the distances of the same points from Philadelphia and from each other. The distances are measured by the route of the public works, and the levels are those of the canal or rail road at the points named.

The mode of using the table will be evident on examination.

Table of elevation and distances on the main line of the Pennsylvania Internal Improvements.	Philadelphia.	Mine ridge summit.	Columbia.	Middletown.	Harrisburg.	Duncan's Island.	Huntingdon.	Hollidaysburg.	Blair's Gap Summit.	Johnstown.	Blairsville.	Freeport.	Pittsburgh.
Philadelphia. . . .		feet 560	237	290	312	332	604	928	2327	1151	904	761	680
Mine ridge summit. .	miles 52		323	270	248	228	44	368	1767	591	344	201	120
Columbia.	82	30		53	75	95	367	691	2090	914	667	524	443
Middletown. . . .	101	49	19		22	42	314	638	2037	861	614	471	390
Harrisburg. . . .	110	58	28	9		20	292	616	2015	839	592	449	368
Duncan's Island. . .	125	73	43	24	15		272	596	1995	819	572	429	348
Huntingdon. . . .	215	163	133	114	105	90		324	1723	547	300	157	76
Hollidaysburg. . .	251	202	172	153	144	129	39		1399	223	24	167	248
Blair's Gap Summit .	264	212	182	163	154	139	49	10		1176	1423	1566	1647
Johnstown. . . .	291	239	209	190	181	166	76	37	27		247	390	471
Blairsville.	321	269	239	220	211	196	106	67	57	30		143	224
Freeport.	366	314	284	265	256	241	151	112	102	75	44		81
Pittsburg.	395	343	313	294	285	270	180	141	131	104	74	29	

It was my intention to have added to this some account of the Branch canals, but it would increase the length of my communication too much, and must be deferred for the present. They are of great extent and importance.

Art. X.—*On the Analysis of Square Numbers*, by A. D. Wheeler, Instructor of the Latin Grammar School, Salem, Mass.

The following properties, appertaining to square numbers, are curious, and of frequent use in Analytical investigations. Several of them have been demonstrated by Fermat and Euler, but the demonstrations here given are in my opinion, more simple and direct.

1. If A and B contain each, the sum of two square numbers, their product A·B will also, contain the sum of two square numbers.

Demonstration. Let $A=a^2+b^2$, and $B=c^2+d^2$, then,

$$A\cdot B=(a^2+b^2)\cdot(c^2+d^2)=(ac+bd)^2+(ad-bc)^2 [A]\text{; or,}$$

$$A\cdot B=(a^2+b^2)\cdot(c^2+d^2)=(ac-bd)^2+(ad+bc)^2 [B.] \text{ Q.E.D.}$$

Remarks. I. When neither a and b, nor c and d, are equal to each other, it is evident that the product $A \cdot B$ contains the sum of two squares in two different ways.

II. When $a=b$, both powers are reduced to one; viz.

$$A \cdot B=(ac+ad)^2+(ad-ac)^2.$$

III. When $b=0$, both forms are reduced to one; viz.

$$A \cdot B=(ac)^2+(ad)^2.$$

IV. When $a=c$, we have $A \cdot B=(a^2+bd)^2+(ad-ab)^2$.

and $A \cdot B=(a^2-bd)^2+(ad+ab)^2$;

expressions which still afford two different sets of squares.

V. If $a=c$, and $b=d$, the expression [A] becomes $(a^2+b^2)^2= (a^2+b^2)^2+(ad-ad)^2=(a^2+b^2)^2+(O)^2$; while [B] assumes the form, given by Souri, Bonnycastle, and others, for finding two square numbers, whose sum shall be a square: viz. $(a^2+b^2)^2= (a^2-b^2)^2+(2ab)^2$.

VI. If $a=b$, and $c=d$, both expressions assume an identical form, $(2ac)^2=(2ac)^2$, from which nothing can be determined.

VII. If $a=1$, and $b=1$, both expressions [A] and [B] take this form, $2(c^2+d^2)=(c+d)^2+(c-d)^2$. Whence it appears that if a given number contain the sum of two squares, the double of that number will also contain the sum of two squares, but generally only in one way.

VIII. Finally, if $a^2+b^2=c^2+d^2$, while neither the values of a and b, nor of c and d, are alike, we have the expressions,

$A \cdot B=A^2=(a^2+b^2)^2=(ac+bd)^2+(ad-bc)^2$, and

$(a^2+b^2)^2=(ac-bd)^2+(ad+bc)^2$; that is, a square number that contains the sum of two squares in two different ways.

Note.—The condition $a^2+b^2=c^2+d^2$, is satisfied at once by substituting the forms of $A \cdot B$, exhibited in [A] and [B]. But if $a^2+b^2=c^2+d^2$; then $(a^2+b^2)\cdot(m^2+n^2)=(c^2+d^2)\cdot(m^2+n^2)$. Now $(a^2+b^2)\cdot(m^2+n^2)=(am\pm bn)^2+(an\mp bm)^2=\alpha^2+\beta^2=\gamma^2+\delta^2$ and $(c^2+d^2)\cdot(m^2+n^2)=(cm\pm dn)^2+(cn\mp dm)^2=\varepsilon^2+\zeta^2=\eta^2+\theta^2$, by employing the change of signs. But

$(\alpha^2+\beta^2)\cdot(\gamma^2+\delta^2)=(\alpha^2+\beta^2)=(\alpha\gamma\pm\beta\delta)^2+(\alpha\delta\mp\beta\gamma)^2$, and

$(\varepsilon^2+\zeta^2)\cdot(\eta^2+\theta^2)=(\alpha^2+\beta)^2=(\varepsilon\eta\pm\zeta\theta)^2+(\varepsilon\theta\mp\zeta\eta)^2$. Thus we have found a square number, $(\alpha^2+\beta^2)^2$, which may be resolved into the sum of two squares in four different ways. In this way we may proceed, till we have found a square number that can be resolved into as many sets of squares as we please. But a better method is the following.

2. If $A^2=B^2+C^2$, then $A^4=D^2+E^2=F^2+G^2$; that is, if any square number contain the sum of two squares, the square of that number will contain the sum of two squares in two different ways.

Demonstration $a^4=(b^2+c^2)^2=(b^2-c^2)^2+(2bc)^2=a^2b^2+a^2c^2$.

3. If A^4 and B^4 contain each, the sum of two squares in two different ways, then $A^4\cdot B^4$ will contain the sum of two squares in twelve different ways.

Demonstration. Put $A^4=a^2+b^2=c^2+d^2$

and $B^4=m^2+n^2=y^2+z^2$;

then $A^4\cdot B^4=(m^2+n^2)\cdot(a^2+b^2)=\alpha^2+\beta^2=\gamma^2+\delta^2$

„ $=(m^2+n^2)\cdot(c^2+d^2)=\varepsilon^2+\zeta^2=\eta^2+\theta^2$

„ $=(y^2+z^2)\cdot(a^2+b^2)=\iota^2+\kappa^2=\lambda^2+\mu^2$,

„ $=(y^2+z^2)\cdot(c^2+d^2)=\nu^2+\xi^2=o^2+\pi^2$; making in all eight sets of squares, deducible from the general expressions [A] and [B]. In addition to these, we may derive four sets more from the simple multiplication of the expressions representing the value of $A^4\cdot B^4$.

For $(m^2+n^2)\cdot(a^2+b^2)=m^2(a^2+b^2)+n^2(a^2+b^2)=m^2A^4+n^2A^4$,

$(m^2+n^2)\cdot(a^2+b^2)=a^2(m^2+n^2)+b^2(m^2+n^2)=a^2B^4+b^2B^4$,

$(y^2+z^2)\cdot(c^2+d^2)=y^2(c^2+d^2)+z^2(c^2+d^2)=y^2A^4+z^2A^4$,

$(y^2+z^2)\cdot(c^2+d^2)=c^2(y^2+z^2)+d^2(y^2+z^2)=c^2B^4+d^2B^4$.

Q. E. D.

Remark.—The product $A^4\cdot B^4=(A\cdot B)^4$. It may be shown that A and B each equal the sum of two squares when A^2 and B^2 each equal the sum of two squares. Therefore the fourth power of the product of any two numbers that are prime to each other, and that consist each of the sum of two squares, may be resolved into the sum of two squares in twelve different ways. The smallest number that can be thus resolved is $(5.13)^4=65^4$. In the same way it may be shown that the expression $(A\cdot B)^8$, or the number 65^8 may be resolved into the sum of two squares in *eighty four* different ways.

4. A convenient method for finding two squares whose sum shall be a square, is the following. Let $a^2-b^2=c^2$. For c^2 put any square number whatever; then, by the common rule, representing by m and n, any unequal factors of c^2, we have $a=\frac{m+n}{2}$, and $b=\frac{m-n}{2}$.

Putting for c^2 any square number $\alpha^2\beta^2\gamma^2$ where α,β,γ, represent any prime factors, we have $2a=\alpha^2\beta^2\gamma^2+1=\alpha^2\beta^2\gamma+\gamma=\alpha^2\beta^2+\gamma^2=$

$\alpha^2\beta+\beta\gamma^2=\alpha^2+\beta^2\gamma^2=\alpha.\alpha\beta^2\gamma^2$ and as many corresponding values for $2b$. So for any greater number of prime factors, $\alpha^2\beta^2\gamma^2\delta^2$ &c.

Thus we see that an hypothenuse or a base may be found, upon which may be constructed any required number of right angled triangles, whose sides shall all be rational integers.

5. When P is neither a square nor the sum of two squares; the product P·Q cannot contain the sum of two squares, except where Q takes the forms $P(m^2+n^2)$, $P^3(m^2+n^2)$, $4P(m^2+n^2)$, &c.—that is, when P and Q have a common divisor.

For if Q be separated into any two parts whatever, (when P and Q are prime to each other,) it is manifest that $Px+Py=P\cdot Q$ is not the sum of two squares, whether x and y are squares or not.

6. Every number which is the sum of two squares that are prime to each other, is either a prime number, or divisible only by factors which are also the sum of two squares.

For, if we suppose that $\frac{a^2+b^2}{P}=Q$; then $a^2+b^2=P\cdot Q$, which has been shown to be impossible.

Corollary. Hence, if $A^2=D^2+C^2$; then $A=c^2+d^2$, as was asserted in a previous remark.

Art. XI.—*Experiments with Potassium and Sodium;* by Julius T. Ducatel, M. D., Professor of Chemistry, in the Medical Department of the University of Maryland.

Serullas says that a piece of *Potassium* put upon a bath of Mercury, gradually amalgamates, acquiring a rotary motion, due to its action on the water in the atmosphere, which evolves hydrogen. In dry air the amalgamation takes place without motion. But if pieces of *Sodium* be thrown upon Mercury, they are again thrown off with slight explosions, accompanied with light and caloric. On the other hand, Potassium burns on the surface of water, while Sodium decomposes it without producing combustion.* These effects of the two

* I observed many years ago, that on hot water sodium scintillates, and even blazes.—Ed.

metals on water appear to be due to the superior temperature acquired by the potassium, while that obtained by the sodium is not sufficient for the purpose : for, if a solution of gum-arabic be used, not too dense nor too thin, then the sodium fires ; because the fragments, being retained at one point, become sufficiently heated ; they ignite ; burn with a yellow flame, and then move over the surface of the fluid like potassium. Again, according to Serullas, if sodium be fixed upon a bad conductor of caloric, as wood, then water will fire it ; but if it be placed upon glass, or porcelain, then the effect will not be produced ; the abstraction of caloric in these cases, as well as in that when a surface of pure water is used, being too rapid to allow the necessary elevation of temperature.

In the fourth American Edition of Dr. Turner's Elements of Chemistry, edited by Dr. Franklin Bache, of Philadelphia, it is stated, that when sodium is thrown into water, it swims upon its surface, occasions violent effervescence and a hissing noise, and is rapidly oxidated, but no light is visible. The action is stronger, it is added, with hot water, and a few scintillations appear ; but still there is no flame. Upon which Dr. Bache remarks, that the sodium which he has had occasion to use, uniformly inflames on *boiling* water ; and he invites the attention of chemical lecturers to the latter experiment. I have frequently repeated Dr. Bache's experiment, and always with success. But it has occurred to me, that the phenomenon would be made much more satisfactory to a class, by adopting some mode of firing the sodium on *cold* water. With a view to this, Serullas's experiments were repeated with the following results.

1. A *mucilage* made with one drachm of powdered gum arabic, and half an ounce of water, will inflame sodium, most probably for the reasons assigned by Serullas, as stated above.

2. On *wood*, sodium most generally inflames in contact with a drop of *cold* water ; the action being at the same time so violent as to cause the globule of metal to roll along the *dry* surface of the table with considerable rapidity, leaving a white streak of caustic soda over its path. This experiment, however, does not always succeed.

3. On a *pane* of *glass*, sodium will not inflame, when the glass is clean and smooth ; but any particles of dust adhering to it will cause the firing of the metal, with scintillations.

4. On a *metallic* surface the sodium could in no instance be made to inflame.

5. On *charcoal,* which is not mentioned by Serullas, sodium never fails to inflame, with brilliant scintillations. This is the mode which I adopt with most confidence, for firing sodium in contact with *cold* water. It confirms the truth of the reason given by Serullas, why sodium will not inflame under the same circumstances as potassium; namely, the superior temperature which the latter acquires, during its combination with the oxygen of the water: hence the necessity of placing the former on a bad conductor, in order to avoid the too rapid abstraction of caloric, which prevents a sufficient elevation of temperature for manifesting the phenomenon of combustion.

6. It is commonly stated, that in the decomposition of water by *sodium,* pure hydrogen is evolved. This is a mistake. A portion of the metal, as in the case of potassium, combines with the hydrogen, as may be shown by the following experiment.—Take a globule of sodium, wrap it up in a small piece of paper, and introduce it under a small receiver provided with a stop-cock and jet, filled with water and standing over the pneumatic trough. The decomposition of the water will be effected as usual, and *sodiuretted hydrogen* will be collected, which (on opening the jet attached to the receiver) being inflamed, burns with a characteristic bright yellow flame. *Potassiuretted hydrogen*, obtained under the same circumstances, burns with a rose-colored flame fringed with blue. The potassium in several repetitions of this experiment always emitted light; the sodium did not.

7. A globule of *potassium* placed on a bath of mercury gradually amalgamates with the latter, without any rotary motion, if the atmosphere be dry; but when breathed upon, it immediately acquires, as observed by Serullas, a very rapid revolving motion, which continues for a long time. The surface of the mercury becomes tarnished, apparently by the accumulation of minute particles of the amalgam formed, which, at intervals are seen to emerge from beneath the surface of the mercury, and at some distance from the large globule. The surface of the liquid metal, within a circle of half an inch to an inch in diameter, retains its brilliancy. The minute particles of amalgam, which I suppose to be the cause of the tarnish, seem to be repelled by the large globule of potassium, and, occasionally, as new accessions are made to them, they become singularly agitated, exhibiting somewhat of the appearance observed when a drop of vinegar, or of an acid, comes in contact with a drop of water.

8. Small pieces of sodium projected upon a bath of mercury, were not found to exhibit the phenomena indicated by Serullas; that is, they were not thrown off with explosions accompanied with light and caloric. The effects are, however, curious. The amalgamation of the sodium takes place slowly, without any rotary motion; although sometimes, when breathed upon, a motion of short duration is induced. When several pieces are put upon the bath at the same time, they show no disposition to come together, but rather the contrary. But when one piece is pushed towards another, there appears to be, within a certain distance, an attractive force exerted, which is immediately succeeded by a repulsive one of some comparative energy. Many pieces being accumulated in a small space, they become violently agitated, as if alternately attracting and repelling each other, until they finally separate.

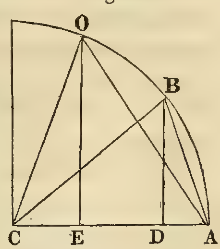
University of Maryland, August 1st, 1833.

Art. XII.—*On the application of the Fluxional Ratio to particular cases; and the coincidence of the several orders of Fluxions, with the binomial theorem;* by Elizur Wright, Esq.

Concluded from Vol. xxiv. p. 312.

By comparing fluxions with trigonometry in regard to properties, features, and results, we shall find a striking analogy to exist between them; in trigonometry the triangles must be similar, for between an equilateral and a scalene triangle the relation of proportion does not exist; so in fluxions no proportion exists between two fluents and their fluxions, when those fluents are dissimilar; for instance, in the two consecutive fluents ABD, AOE (Fig. 6.) the correspondent lines AB, AO, are not parallel, and by the definition not similar; consequently the fluents ABD, AOE, are not proportional to their fluxions.

Fig. 6.



In trigonometry, if the three sides of any triangle whatever are similar to the three sides of another triangle, the like sides are proportional; in fluxions, if any fluxional quantity whatever is similarly constituted as another given fluxional quantity, the relation of proportion between the fluxions and their respective fluents subsists.

In trigonometry, the fourth term may be had by multiplying the third term by the ratio; in fluxions, the fluent, which is here the fourth term, is likewise had by multiplying the fluxion, which is the third term, by the fluxional ratio. Therefore, since the results are obtained by the same means, the same relation obtains in both, which is that of proportion.

On fluxions of the higher orders.

When in the generation of a variable quantity, its fluxion is different at different points in its production, it may be considered as a fluent, and its fluxion taken, which is called the second fluxion. And when the second fluxion varies, the fluxion of this fluxion may be taken; and in general a variable quantity admits of as many orders of fluxions, as the exponent of the power contains units.

Of the second power x^2
the first fluxion is $2x\dot{x}$
the second fluxion, $2\dot{x}^2$
the third fluxion, 0

Of the third power x^3
the first fluxion is $3x^2\dot{x}$
the second fluxion, $6x\dot{x}^2$
the third fluxion, $6\dot{x}^3$
the fourth fluxion, 0

Of the fourth power x^4
the first fluxion is $4x^3\dot{x}$
the second fluxion, $12x^2\dot{x}^2$
the third fluxion, $24x\dot{x}^3$
the fourth fluxion, $24\dot{x}^4$
the fifth fluxion, 0

In passing from any order of fluxions to the next higher order, inasmuch as the quantity $\dot{x}$ becomes invariable, the exponent of the variable part is diminished by 1; hence the ratio for second fluxions is $\frac{(n-1)\dot{x}}{x}$, for third fluxions it is $\frac{(n-2)\dot{x}}{x}$, for fourth fluxions it is $\frac{(n-3)\dot{x}}{x}$, and so on; generally,

(1) $x^n \times \frac{n\dot{x}}{x} = nx^{n-1}\dot{x}$, the first fluxion.

$nx^{n-1}\dot{x} \times \frac{(n-1)\dot{x}}{x} = n(n-1)x^{n-2}\dot{x}^2$, the second fluxion.

$n(n-1)x^{n-2}\dot{x}^2 \times \frac{(n-2)\dot{x}}{x} = n(n-1)(n-2)x^{n-3}\dot{x}^3$, the third fluxion.

$$n(n-1)(n-2)x^{n-3}\dot{x}^3 \times \frac{(n-3)\dot{x}}{x} = n(n-1)(n-2)(n-3)x^{n-4}\dot{x}^4,$$

the fourth fluxion.

Let x' be the increment of x, then if $x+x'$ be raised successively to the several powers, the increment of

x^2 will be $2xx'+x'^2$

x^3 $\quad 3x^2x'+3xx'^2+x'^3$

x^4 $\quad 4x^3x'+6x^2x'^2+4xx'^3+x'^4$

In any given power, suppose the first fluxion divided by the indeterminate quantity A, the second fluxion divided by the indeterminate quantity B, the third by C, &c. to be equal, each, to the corresponding term in the increment, $\dot{x}$ being supposed equal to x'; then all the orders of fluxions, taken until the variable quantity becomes constant, will be equal to the whole increment, because all the parts taken together are equal to the whole. The values of these unknown coefficients are found in the following manner; suppose $x+x'$ is raised to a given power, for instance the third, then the increment will be $3x^2x' + 3xx'^2+x'^3$; the first fluxion will be $3x^2\dot{x}$; the second fluxion, $6x\dot{x}^2$; and the third fluxion, $6\dot{x}^3$; then $\frac{3x^2\dot{x}}{A}+\frac{6x\dot{x}^2}{B}+\frac{6\dot{x}^3}{C}=3x^2x' +3xx'^2+x'^3$. By supposition $\frac{3x^2\dot{x}}{A}=3x^2x'$, and $\frac{6x\dot{x}^2}{B}=3xx'^2$, and $\frac{6\dot{x}^3}{C}=x'^3$, hence A=1, B=2, C=6; therefore $\frac{3x^2\dot{x}}{1}+\frac{6x\dot{x}^2}{2} +\frac{6\dot{x}^3}{6}=3x^2x'+3xx'^2+x'^3$, the increment. When $x+x'$ is raised to the fourth power, the increment will be $4x^3x'+6x^2x'^2+4xx'^3+ x'^4$. Proceeding as before $\frac{4x^3\dot{x}}{A}+\frac{12x^2\dot{x}^2}{B}+\frac{24x\dot{x}^3}{C}+\frac{24\dot{x}^4}{D}= 4x^3x'+6x^2x'^2+4xx'^3+x'^4$. By supposition $\frac{4x^3\dot{x}}{A}=4x^3x'$, hence A=1; $\frac{12x^2\dot{x}^2}{B}=6x^2x'^2$, hence B=2; $\frac{24x\dot{x}^3}{C}=4xx'^3$, hence C= 6; $\frac{24\dot{x}^4}{D}=x'^4$, hence D=24. Therefore $\frac{4x^3\dot{x}}{1}+\frac{12x^2\dot{x}^2}{2}+ \frac{24x\dot{x}^3}{6}+\frac{24\dot{x}^4}{24}=4x^3x'+6x^2x'^2+4xx'^3+x'^4$, the increment. To avoid the difficulty of indicating by points a fluxion of a very high order, when we wish to express it generally, $\ddot{x}$ may be written $[x]^2$, and $\dddot{x}$ may be written $[x]^3$ and so on. Suppose that E represents any power x^n generally, the fluxions of the several orders are expressed in the following manner. In the preceding case n stands for the exponent 4, and E stands for x^4; $[E]^1$ for $4x^3x^{\cdot}$, the first fluxion; $[E]^2$ for $12x^2x^{\cdot 2}$ the second fluxion; $[E]^3$ for $24xx^{\cdot 3}$ the third fluxion; $[E]^4$ for $24x^{\cdot 4}$ the fourth fluxion; hence $4x^3x^{\cdot}+\frac{12x^2x^{\cdot 2}}{2}+\frac{24xx^{\cdot 3}}{6}+\frac{24x^{\cdot 4}}{24}=[E]^1+\frac{[E]^2}{2}+\frac{[E]^3}{6}+\frac{[E]^4}{24}=$increment. The larger the exponent n is taken, the greater will be the number of terms, of which the series is composed. When n is indefinitely large, the series becomes infinite, and in that case E stands for x^n; $[E]^1$ for $nx^{n-1}x^{\cdot}$; $[E]^2$ for $n(n-1)x^{n-2}x^{\cdot 2}$; $[E]^3$ for $n(n-1)(n-2)x^{n-3}x^{\cdot 3}$; $[E]^4$ for $n(n-1)(n-2)(n-3)x^{n-4}x^{\cdot 4}$; $[E]^5$ for $n(n-1)(n-2)(n-3)(n-4)x^{n-5}x^{\cdot 5}$; &c. The series expressing the *orders of fluxions* becomes (1.) $[E]^1+[E]^2+[E]^3+[E]^4+[E]^5+[E]^6+$&c.... in inf. and the series expressing the *increment* becomes

$$(2.)\ (x+x')^n-x^n=[E]^1+\frac{[E]^2}{2}+\frac{[E]^3}{2.3}+\frac{[E]^4}{2.3.4}+\frac{[E]^5}{2.3.4.5}+\text{\&c...}$$

in inf.=increment.

The series of Maclaurin is

$$(3.)\ y=E+\frac{[E]^1}{z^{\cdot}}z+\frac{[E]^2}{2z^{\cdot 2}}z^2+\frac{[E]^3}{2.3z^{\cdot 3}}z^3+\frac{[E]^4}{2.3.4z^{\cdot 4}}z^4+\frac{[E]^5}{2.3.4.5z^{\cdot 5}}z^5+\text{\&c.}$$

The series of Taylor is,

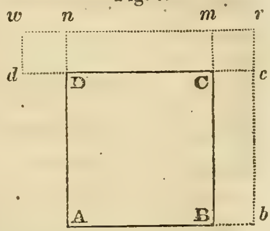
$$(4.)\ f(x+h)=y+\frac{[y]^1h}{x^{\cdot}}+\frac{[y]^2}{x^{\cdot 2}}\frac{h}{2}+\frac{[y]^3}{x^{\cdot 3}}\frac{h}{2.3}+\frac{[y]^4}{x^{\cdot 4}}\frac{h}{2.3.4}+\text{\&c.}$$

The binomial series is,

$$(5.)(x+h)^n=x^n+nx^{n-1}h+n.\frac{n-1}{2}x^{n-2}h^2+n.\frac{n-1}{2}.\frac{n-2}{3}x^{n-3}h^3+\text{\&c.}$$

If in the series of Taylor we make $[y]h=[E]$, and $x^{\cdot}=1$, and in the series of Maclaurin, if we make z and $z^{\cdot}$ each, equal to 1, they will coincide with the preceding series. These series indicate, what share each of the orders of fluxions has in forming the increment, and disclose the relation of the several orders of fluxions to the fluent, included in the following properties. 1. When $x+x'$ represents a binomial root, in which x is the original fluent, and x' its increment, equal to the fluxional base $\dot{x}$, then if $x+x'$ be raised to any assignable power, the result will be equal to the sum of that original fluent, its first fluxion, half of its second fluxion, one sixth of its third fluxion, one twenty-fourth of its fourth fluxion, &c. continued until its last fluxion is a constant quantity. 2. Each order of fluxions has as many sources of increase, from whence the generating quantities commence their motion, as there are units in the coefficient of its fluxion. Since for a right understanding of the nature of fluxions, much depends on a thorough understanding of these elements, they demand an attentive consideration.

Fig. 7.



In the second power, the first fluxion has two sources of increase, DC, and CB, and the second fluxion two, C*c*, and D*n*. The two generating lines commence their motion at DC, CB, producing the two parallelograms D*nm*C, C*cb*B, representing the first fluxion $2x\dot{x}$, and the two generating lines C*c*, D*n*, commence their motion at C*c*, D*n*, producing the two squares C*crm*, D*nwd*, representing the second fluxion $2\dot{x}^2$.

The manner in which the several orders of fluxions arise in the third power, is made plain by the diagrams annexed to the article, page 330 in the xiv. Vol. of the Journal of Science, to which the reader is referred. First fluxions are there designated by the short prisms of a red color, second fluxions by the prisms of a yellow color, and third fluxions by the cubes of a blue color. The three generating squares are described as commencing their motion at the bases of the three pyramids, which compose the fluent, forming the three short prisms of a red color, whose thickness is $\dot{x}$. These prisms represent the first fluxion $3x^2\dot{x}$. Nextly, the six generating parallelograms, whose length is equal to a side of the generating squares just mentioned, and width equal to $\dot{x}$, commence their motion from the two flowing sides in each of the short prisms, and produce the six quadrangular prisms of a yellow color, representing the second fluxion $6x\dot{x}^2$. Lastly, the six generating squares, whose sides are each equal to $\dot{x}$, commence their motion at the ends of the six prisms of a yellow color, which are supposed to flow, and to produce the six cubes of a blue color, representing the third fluxion $6\dot{x}^3$.

If the foregoing series marked (2) (3) (4) (5) be compared with the orders of fluxions marked (1), a remarkable coincidence will be observed. If the nature of the relation, which exists between fluxions and their fluents, is sought for; if it should be asked, what is the *rationale* of the result? and why does this coincidence take place? the answer will be, that these series contain the elements of the ratio $\frac{n\dot{x}}{x}$ by the multiplication of which, or its modification, into the expression of any order immediately preceding, the fluxion of the order next following is produced.

To illustrate this, let them be brought into one form, and exemplified in the function x^n. When properly arranged they will stand thus,

Orders of fluxions,	fluent x^n	$nx^{n-1}\dot{x}$	$n(n-1)x^{n-2}\dot{x}^2$	$n(n-1)(n-2)x^{n-3}\dot{x}^3$
Series of Taylor,	x^n	$nx^{n-1}\dot{x}$	$n(n-1)x^{n-2}\frac{\dot{x}^2}{2}$	$n(n-1)(n-2)x^{n-3}\frac{\dot{x}^3}{2.3}$
Binomial series,	x^n	$nx^{n-1}\dot{x}$	$n\frac{(n-1)}{2}x^{n-2}\dot{x}^2$	$n\frac{(n-1)}{2}\frac{(n-2)}{3}x^{n-3}\dot{x}^3$.

Here in the series of Taylor, y is represented by x^n, and h by $\dot{x}$, and $\dot{x}$ by 1; in the binomial series h is represented by $\dot{x}$.

In the orders of fluxions, the fluent x^n multiplied by the fluxional ratio $\frac{n\dot{x}}{x}$ produces $nx^{n-1}\dot{x}$ the first fluxion; this, considering $\dot{x}$ a constant quantity, multiplied by $\frac{(n-1)\dot{x}}{x}$, the ratio for fluxions of the second order, produces $n(n-1)x^{n-2}\dot{x}^2$ the second fluxion. Multiplying the second fluxion by $\frac{(n-2)\dot{x}}{x}$, the ratio for fluxions of the third order, we obtain $n(n-1)(n-2)x^{n-3}\dot{x}^3$, the third fluxion, and so on.

In the series of Taylor $\frac{[y]}{\dot{x}}$ is expressed by nx^{n-1}, and $\frac{[y]^2}{\dot{x}^2}$ by $n(n-1)x^{n-2}$, and $\frac{[y]^3}{\dot{x}^3}$ by $n(n-1)(n-2)x^{n-3}$, &c. In the second term there is a *complete coincidence*. In the third and fourth terms if the divisors of the factors $\frac{\dot{x}^2}{2}$, $\frac{\dot{x}^3}{2\cdot 3}$, in the series of Taylor be withdrawn, we have the second and third fluxions; if they be transferred to the factors in the same series expressing the coefficients of the third and fourth terms, we have $\frac{n}{1}\cdot\frac{n-1}{2}$, and $\frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{n-2}{3}$, which are the unciæ of the same terms in the binomial series, and the *two series coincide.* These properties apply equally to the remaining terms. Hence, by the aid of the binomial series, the nature of the several orders of fluxions is indicated.

Lagrange, after considering the great utility of the theorem of Taylor in explaining the nature of fluxions, succeeded in demonstrating it without making use of the Calculus. Thinking it may be acceptable to those readers of the Journal of Science, who have a taste for the mathematics, but have made no great proficiency in pursuits of this kind, to see a demonstration of what I believe to be the true foundation of fluxions, brought down to their capacities; I have extracted from *Boucharlat* the method of deriving Taylor's theorem, invented by Lagrange. The process is simplified, and an ellipsis is supplied, necessary to an easy understanding of the demonstration; which may further serve as an apology for introducing that, which has long been known.

Let $f(x+h)$ represent generally a function which has not yet been reduced to a series. To convert this function into a series we may suppose,

$$f(x+h)=fx+\mathrm{P}h$$
$$\mathrm{P}=p+\mathrm{Q}h$$
$$\mathrm{Q}=q+\mathrm{R}h$$
$$\mathrm{R}=r+\mathrm{S}h$$

Substituting for P, Q, R, S, &c. their several values, we have,
$f(x+h)=fx+ph+qh^2+rh^3+sh^4+th^5+$&c. (1.)

In any binomial A $(x+h)$, if x is changed to $x+i$, it will give the same result, when raised to a given power, as it will, when h is changed to $h+i$. For since the root $\mathrm{A}(x+i+h)$ is the same with the root A $(x+h+i)$, they will yield identical results, when raised to any proposed power. Hence it follows, that in the development $fx+ph+qh^2+rh^3+sh^4+$&c. we may first change h into $h+i$, and afterwards x into $x+i$, and still the two results will have the same value.

Substituting $h+i$ for h.

The series marked (1.) in this case becomes,
$f(x+(h+i)=fx+p(h+i)+q(h+i)^2+r(h+i)^3+s(h+i)^4+$ &c.
and writing only the two first terms in each of these binomials we have $f(x+(h+i))=fx+ph+pi+qh^2+2qhi+rh^3+3rh^2i+$&c.(2.)

Substituting $x+i$ for x.

It may here be noticed that the elements p, q, r, s, &c. in the series $fx+ph+qh^2+rh^3+$&c. represent the several functions of x together with their coefficients, in expanding the binomial $(x+h)^n$. Hence $fx+ph+qh^2+rh^3+sh^4+\text{\&c.}=x^n+nx^{n-1}h+\frac{n}{1}\cdot\frac{n-1}{2}\cdot x^{n-2}h^2+\frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{n-2}{3}x^{n-3}h^3+$&c. Substituting $x+i$ for x, it becomes $(x+i)^n+n(x+i)^{n-1}h+\frac{n}{1}\cdot\frac{n-1}{2}(x+i)^{n-2}h^2+\frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{n-2}{3}(x+i)^{n-3}h^3+\text{\&c.}=(x+i)^n+\alpha(x+i)^{n-1}h+\beta(x+i)^{n-2}h^2+\gamma(x+i)^{n-3}h^3+\delta(x+i)^{n-4}h^4+$&c.

The term $(x+i)^n$ being expanded forms the equation,

$$(x+i)^n=x^n+nx^{n-1}i+\frac{n}{1}\cdot\frac{n-1}{2}x^{n-2}i^2+\text{\&c.}$$

Put $n-1$ for n, and the equation becomes,

$$(x+i)^{n-1}=x^{n-1}+\frac{n-1}{1}x^{n-2}i+\frac{n-1}{1}\cdot\frac{n-2}{2}x^{n-3}i^2+\text{\&c.}$$

Put $n-2$ for n, and the equation becomes,

$$(x+i)^{n-2}=x^{n-2}+\frac{n-2}{1}x^{n-3}i+\frac{n-2}{1}\cdot\frac{n-3}{2}x^{n-4}i^2+\text{\&c.}$$

Put $n-3$ for n, and the equation becomes

$$(x+i)^{n-3}=x^{n-3}+\frac{n-3}{1}x^{n-4}i+\frac{n-3}{1}\cdot\frac{n-4}{2}x^{n-5}i^2+\text{\&c.}$$

hence $x^n+ \quad \alpha x^{n-1}i+ \quad \beta x^{n-2}i^2=fx+pi+qi^2$

$$\alpha x^{n-1}+\alpha\frac{n-1}{1}x^{n-2}i\alpha\frac{n-1}{1}\cdot\frac{n-2}{2}x^{n-3}i^2=p+p'i+p''i^2$$

$$\beta x^{n-2}+\beta\frac{n-2}{1}x^{n-3}i\beta\frac{n-2}{1}\cdot\frac{n-3}{2}x^{n-4}i^2=q+q'i+q''i^2$$

$$\gamma x^{n-3}+\gamma\frac{n-3}{1}x^{n-4}i\gamma\frac{n-3}{1}\cdot\frac{n-4}{2}x^{n-5}i^2=r+r'i+r''i^2$$

$$\delta x^{n-4}+\delta\frac{n-4}{1}x^{n-5}i\delta\frac{n-4}{1}\cdot\frac{n-5}{2}x^{n-6}i^2=s+s'i+s''i^2$$

therefore $f((x+i)+h)=x^n+\alpha x^{n-1}i+\beta x^{n-2}i^2+(\alpha x^{n-1}+\alpha\frac{n-1}{1}x^{n-2}i+\alpha\frac{n-1}{1}\cdot\frac{n-2}{2}x^{n-3}i^2)h+(\beta x^{n-2}+\beta\frac{n-2}{1}x^{n-3}i+\beta\frac{n-2}{1}\cdot\frac{n-3}{2}x^{n-4}i^2)h^2+\text{\&c.}=fx+pi+qi+\text{\&c.}+(p+p'i+p''i^2)h+(q+q'i+q''i^2)h^2+(r+r'i+r''i^2)h^3+(s+s'i+s''i^2)h^4+$&c. (3.)

In the equation (3) p is considered as a function of x. Let p be represented by $f'x$, and p' by $f''x$, &c. Inasmuch as the developments (2) (3) are identical, the terms which contain the same powers of h are necessarily equal; consequently if we compare the terms of these two series affected with ih, ih^2, ih^3, &c. we shall find that $2q=p'=f''x$, hence $q=\frac{1}{2}p'=\frac{1}{2}f''x$. Again, $3r=q'=\frac{1}{2}f'''x$, hence $r=\frac{1}{3}q'=\frac{1}{2}.\frac{1}{3}f'''x$. Again, $4s=r'=\frac{1}{2}.\frac{1}{3}f^{\text{IV}}x$, hence $s=\frac{1}{4}r'=\frac{1}{2}.\frac{1}{3}.\frac{1}{4}f^{\text{IV}}x$. Again, $5t=s'=\frac{1}{2}.\frac{1}{3}.\frac{1}{4}f^{\text{V}}x$, hence $t=\frac{1}{5}s'=\frac{1}{2}.\frac{1}{3}.\frac{1}{4}.\frac{1}{5}f^{\text{V}}x$. By thus proceeding we shall find successively all the other coefficients of the equation (1). Substituting in this equation the values of p, q, r, s, &c. we shall have $f(x+h)=fx+f'xh+f''x\frac{h^2}{2}+f'''x\frac{h^3}{2.3}+f^{\text{IV}}x\frac{h^4}{2.3.4}+f^{\text{V}}x\frac{h^5}{2.3.4.5}+\&c.$ (4.) This series is of a very general nature, comprehending that of a power of a common binomial quantity indicated by $(x+h)^n$; that of a power of a logarithmic binomial quantity indicated by log. $(x+h)^n$, and that of a power of a binomial sine or cosine indicated by sin.$(x+h)^n$, or cos.$(x+h)^n$. In the equation (4.) $f'x$, being the coefficient of h in the development of the common binomial quantity, is indicated by αx^{n-1}; $f''x$, being the coefficient of $\frac{h^2}{2}$, is indicated by βx^{n-2}; $f'''x$, being the coefficient of $\frac{h^3}{2.3}$ is indicated by γx^{n-3}, and so on: hence putting these values of $f'x, f''x, f'''x$, &c. in the equation (4), we have $f(x+h)=x^n+\alpha x^{n-1}h+\beta x^{n-2}\frac{h^2}{2}+\gamma x^{n-3}\frac{h^3}{2.3}+\delta x^{n-4}\frac{h^4}{2.3.4}+\&c.$ (5.) which is the common binomial series.

The several orders of fluxions are produced by multiplying their fluxional ratios, each, into the preceding order, that is to say,

$$x^n\times\frac{n\dot{x}}{x}=nx^{n-1}\dot{x}, \text{ the first fluxion.} \qquad (6.)$$

$$nx^{n-1}\dot{x}\times\frac{(n-1)\dot{x}}{x}=n(n-1)x^{n-2}\dot{x}^2, \text{ the second fluxion.} \quad (7.)$$

$$n(n-1)x^{n-2}\dot{x}^2\times\frac{(n-2)\dot{x}}{x}=n(n-1)(n-2)x^{n-3}\dot{x}^3, \text{ the third fluxion.} \quad (8.)$$

Now if we consider equation (5.) we shall perceive that the coefficient of h, in the second term in the development of the binomial $(x+h)^n$, is αx^{n-1}, and is the same with the fluxional coefficient nx^{n-1}

in equation (6.), and is what we designate by $\frac{y^{\cdot}}{x^{\cdot}}$; and that the coefficient of $\frac{h^2}{2}$ in the third term, which is βx^{n-2}, is the same with the fluxional coefficient $n(n-1)x^{n-2}$ in equation (7.) designated by $\frac{[y]^2}{x^{\cdot 2}}$; and that the coefficient of $\frac{h^3}{2.3}$ in the fourth term, which is γx^{n-3}, is the same with the fluxional coefficient $n(n-1)(n-2)x^{n-3}$ in equation (8.) designated by $\frac{[y]^3}{x^{\cdot 3}}$, and so on. These coefficients are represented in equation (4.) by $f'x, f''x, f'''x$, &c. hence by substitution $f(x+h)^n = y + \frac{y^{\cdot}}{x^{\cdot}}h + \frac{[y]^2}{x^{\cdot}}\ \frac{h^2}{2} + \frac{[y]^3}{x^{\cdot 3}}\ \frac{h^3}{2.3} + \frac{[y]^4}{x^{\cdot 4}}\ \frac{h^4}{2.3.4} +$ &c.. (9.). It is in this manner, that, without making use of the Differential Calculus, we arrive at the formula of Taylor, which is in fact the binomial series accommodated to fluxions.

Withdraw the divisors from $\frac{h^2}{2}, \frac{h^3}{2.3}, \frac{h^4}{2.3.4}$, &c. in the series of Taylor, and we have an expression of the several orders of fluxions. Thus it is demonstrated that a relation exists between the binomial theorem and the several orders of fluxions. And since $\frac{y^{\cdot}}{x^{\cdot}}$ must indicate the coefficient of h in the second term of the series, it follows that $\frac{y^{\cdot}}{x^{\cdot}} = nx^{n-1}$, and $y^{\cdot} = nx^{n-1}x^{\cdot}$. Hence it appears that Lagrange had a sufficient reason for assuming the second term of the binomial series for the first fluxion.

It would be no uncommon occurrence, if, when the steps leading to a discovery or improvement are once laid, by those who have gone before us, the same improvement should be made by several individuals. This happened in the separate and nearly cotemporaneous invention of fluxions by Sir Isaac Newton and Leibnitz. And this may possibly be the case in regard to the views of that science here exhibited. No such thing, however, has come to my knowledge. But it is what appears by the VII. Article in No. 47 of the Journal of Science, to have taken place in respect to the invention of a universal method of computing the area of an irregular polygon. While Doct. Stiles was President of Yale College, which must have been previous to the year 1795, my method of solving this problem was transmitted to him for the purpose of being communicated to the American Academy of Arts and Sciences, and I have never yet become acquainted with any other method similar to it. But I deem it unimportant to substantiate the claim of priority in time. *Who first* thought of an improvement is to the public a matter of trivial consequence, and even to the inventor himself, provided he can bring before the public a useful invention, which he can honestly call his *own*. The writer of the VII. Article in No. 47 of the Journal of Science seems to have overlooked the improvement contained in the article he alluded to. It consists in making the first meridian bisect the first side in the calculation, by means of which the two areas of opposite values, formed by the bisection, balance and destroy each other. Hence the first product vanishes, and the number of products, which in the example he has given is four, is reduced to three. The assumption "that the first meridian may pass through any station of the field wherever it may be convenient to commence either the measurement or calculation" is common to both our methods, and lays the foundation for the *algebraical* process of adding and multiplying, recommended for its "simplicity and the universality of its application." If, therefore, we commence the calculation with that side which causes the meridian line to divide the field into nearly equal parts, as the writer proposes; and if, instead of making the meridian line pass through the angular point, we make it bisect the first side, we shall arrive, as I conceive, at the highest improvement of which the problem is susceptible.

Corrections.—Page 303, Vol. xxiv. l. 11 fr. bot. for EG read FG.

" 306, " l. 5 fr. bot. for $\frac{x^{\frac{5}{2}}\dot{x}}{8a^{\frac{3}{2}}}$ read $\frac{x^{\frac{5}{2}}\dot{x}}{8a^{\frac{3}{2}}}$.

" " " in the diagram (Fig. 4.) for I read H.

" 307, " l. 8 fr. bot. for $2a^{\frac{1}{2}}x^{\frac{3}{2}}$ read $\frac{2a^{\frac{1}{2}}x^{\frac{3}{2}}}{3}$.

" 309, " l. 9 fr. bot. for $\frac{1}{ax^{-3}}$ read $\frac{1}{ax^{3}}$.

Art. XIII.—*Notices of Fossil Wood in Ohio; in a letter from* Rev. Sayrs Gazlay, dated Cincinnati, April 30, 1833.

TO PROFESSOR SILLIMAN.

In a former communication respecting wood found in digging a well in Palmyra, Ohio, it was stated, that such facts are so common, in the vicinity, as to excite no surprise. As this last remark seemed to excite your surprise, I have collected the following facts, which I have the pleasure of furnishing you.

About two years ago, a second instance of a similar kind fell under my observation. While the stage stopped at Palmyra, I examined the limb of a tree most resembling elm, taken up the preceding week in digging a well, at the depth of twenty-six feet. It was nine feet long and five inches in diameter. Three pieces of it are now in my possession. It has lost half of its diameter in drying.

Having no further acquaintance with the fossils of Palmyra, I furnish you with a few of the many facts of this kind that might be collected in Springfield, which lies twelve miles south-west of the former place, and fifteen miles north of Cincinnati; it is elevated one hundred feet above the highest river-bottoms, and is seven miles east of the Great Miami.

Mr. Anthony Hills, innkeeper, in the lower part of the village of Springfield, found wood, in digging a well, at the various depths of sixteen, eighteen and twenty feet.

Dr. Jeremiah Braden, in the autumn of 1831, found near that place, several small pieces of wood at the depth of thirty feet; the largest of which was a little less than a man's arm; but he found no more, although he sunk his well to the depth of sixty-five feet.

John Miller, one mile north of Springfield, on ground about fifteen feet lower, found wood at the depth of twenty feet. Between this place and Springfield, the ground is forty feet lower, than at those places. Near Mr. Miller's, and where the surface is about twenty feet lower, Archibald Martin found wood, sticks and leaves, twenty feet from the surface. His well is forty feet deep. Mr. Miller, upon another farm of his, found also a part of a tree, five inches in diameter, which, from the knots being numerous upon it, he judged to be pine or spruce. This was three miles east of Springfield.

Michael Long, a mile southwest of the last mentioned place, dug two wells, and found wood in each, the trees lying quite across the whole shafts. These were at various depths—some were more than forty feet below the surface.

Harp Peterson, half a mile north-east of Mr. Long's, dug three wells, in each of which, he found grape vines, and a stratum of soil, or black mould four feet thick. In one of these he found lying across the well, a tree nine inches in diameter, which he supposed to be pine or cedar. In conversation with him upon the subject, he remarked, "It is no great miracle, to find wood in digging wells here." The place where these wells were dug, is near the top of a ridge, from which the ground gradually descends, in every direction, for about half a mile. The wood, in each, was found thirty feet below the surface.

William Slayback, in 1825, two miles and a half west of Springfield, found a tree twelve inches in diameter, lying horizontally, at the depth of thirty-six feet; and it being necessary to cut the tree, I have obtained a piece sawed from one end of it, fourteen inches long and in good preservation. It is now eight inches in diameter. In digging another well a few rods from the former, he found several small pieces of wood, at the depth of twenty-five feet. The farther digging of the well he was compelled to abandon, on account of the looseness of the earth.

William Bellas, about thirty rods from the preceding, on ground a little higher, sunk two wells in 1827, in both of which he occasionally found wood from seventeen to thirty-five feet below the surface. On account of the looseness of the earth, he left digging when he had come upon the top of a tree lying horizontally. He remarked to me, that he had not known a well dug any where in his vicinity, without finding wood. The wood was found in a bluish earth, mixed with gravel, which continued, below seventeen feet to the depth of thirty-five feet.

Forty rods north of the preceding, wood was found in each of three wells, at the depth of twenty feet, on the farm of Thomas Skillman. The ground slopes all the distance from the site of Mr. Skillman's wells, to that of Mr. Slaybach; the distance is about forty rods, and the descent about twenty feet, so that the wood of the former was about even with the surface of the latter. What is more particularly worthy of remark, in relation to the three wells of Mr. Skillman, is, that they were dug upon the top of a ridge, and upon the highest point of it, the ground sloping more gradually north and south, and descending more abruptly east and west, and no higher ground being in view from the spot. No stream of water large enough to drive a mill, is nearer to the place than the Great Miami, which is five miles to the west.

William Huston, one mile farther west than Skillman's, on ground about twenty five feet lower, dug a well in 1830, in which he found wood almost continually, after he had descended eighteen feet, and he continued to find it to the depth of forty-five feet. At the depth of forty feet, he found a tree twelve inches in diameter crossing the well. He is of opinion that he found wood in his well sufficient to fill the body of a cart. He gave me a piece of it, five inches in diameter, and a foot long, which is now in my possession.

Samuel Newel, more than a mile west of Springfield, in digging a well, came upon the top of a tree lying almost horizontally, at the depth of twenty four feet, at which depth he relinquished digging, on account of the sides of the well caving in, and commenced again about two rods from the other place, on ground about two feet higher, the ground gently sloping for some distance. In this second well he came upon the same tree, at the depth of twenty feet, uncovering the trunk near the root, the trunk there being broken, as is not uncommon with fallen trees.

Mr. Compton, in the summer of 1832, found wood in digging a well at the depth of nineteen feet. Some specimens are in my possession. This place is more than a mile south of Springfield, and a mile east of Mr. Long's, before mentioned.

Other similar facts are in my knowledge, collected in the vicinity, which I forbear to detail, on account of their similarity.

Eighteen miles north-east of Springfield, on the east side of the Little Miami, and four miles from this river, Thomas Dickey, Esq. found wood, in digging a well last summer, at the depth of sixteen feet. Two pieces of these I procured of him last week ; one was taken from the top of a stump near the place, and the other lying on the ground. In explanation of their being thus left in the weather during the winter, and so in danger of being lost, he remarked that such facts were common in his neighborhood.

It is obvious from the facts respecting Mr. Newel's wells, that the ground about Springfield had a more uneven surface, before these trees were covered, than at present ; for the surface, which now slopes two feet in two rods, then sloped six feet in the same distance, and even more if the branches of the tree bore the top from the ground, higher than the roots, which is common, when trees have ramose tops.

Two instances of wood found in digging upon the river bottoms, have come to my knowledge, one about five miles from Springfield, on Mill-creek bottom, at the depth of thirty feet, and one at Cincinnati, on the Ohio bottom, at the depth of thirty-five feet.

The instances of fossil wood in Ohio with which I am acquainted, are much more numerous upon the upland or table land, than upon the bottoms.

The quantity of this wood and its so general dispersion, clearly evince that it has not fallen into fissures of the earth, opened by earthquakes; besides, strata of soil or black mould, are frequently met with, which have every appearance of having been the surface: they vary from six inches to four feet in thickness, and are generally interspersed with grape vines and the appearance of leaves and drift.* The tree in Mr. Newel's wells, induces the opinion that the trees grew where they now lie; for it was broken in the trunk near the root, and yet both parts lay in a conformable position, except that the ends of both parts at the fracture were lower than if the trunk had not been broken, i. e. it was sunken at the broken place; which facts cannot easily be accounted for, unless we suppose that it now lies where it originally fell.

There is not a primitive rock in this region, except bowlders of granite, which have evidently been transported from another and a northern region. They are numerous in Ohio, but there is not one in Kentucky; from the Ohio river the banks are too high, for those bowlders to have been carried up by water, which would turn its course after meeting the river and follow down its bed. The conformable rocks are universally transition limestone, fragments of which lie unconformably in all cases interspersed with the bluish gravelly earth, above the fossil wood.

There are two indications here of two former inundations. Granite bowlders are lying on the surface of the earth, under which whole trees are lying at the depth of forty feet; and such bowlders are also found lying upon conformable transition lime rocks.

I have made inquiry respecting conformable rocks overlying fossil wood; but have not learned one instance of such a fact.

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* This is the language used in giving me information, and means such vegetables as are thrown together by swollen streams.

Art. XIV.—*Fossil Vegetables.*

Mr. Witham of Lartington, Yorkshire, England, (also of Edinburgh) has favored the scientific world with two very interesting memoirs on fossil vegetables. They evince great skill and care in developing the facts, and in illustrating them by the most beautiful colored sections, exhibiting the internal vegetable structure, which he has developed by a new method of examination by the microscope.

By comparing the fossil specimens with those of recent vegetables, which also he has examined by the microscope, he thinks he can detect the true character and species of the fossil plant. Among many others, he describes a fossil tree, discovered in 1826 in a quarry near Edinburgh, which is a most curious and interesting fragment of an earlier world. It was found one hundred and thirty-six feet below the surface, in a horizontal position, nearly parallel with the stratum of sandstone in which it was imbedded, and measured thirty-six feet in height, and three feet in diameter at its base. This remnant of primitive vegetation appears to have been a conifera, and from comparing the structure with the Norway Fir, and the Yew-tree, the resemblance is surprising, and if not identical, may confidently be referred to that family. The cells and layers of the woody fibre are evident, although foreign substances have, by percolation, taken possession of the decaying part of the plant. In some parts, masses of crystals or other mineral substances in patches and irregular streaks, have displaced the vegetable, but the whole is sufficiently entire to indicate its resemblance to the living tree. The bark or rind was of a coally substance.

Another fossil stem has been recently discovered in the quarry of Craigleith near Edinburgh, whose geological position is in the mountain limestone group, and considerably below the great coal basins of the Lothians. Its elevation is seventy-five feet above the level of the sea and its roots were at the bottom of the quarry. The length of the stem was forty-seven feet—a large, branchless trunk—in some parts, much flattened so as to afford an elliptical section. Its largest diameter is five feet by two, and its smallest, one foot and seven inches by one foot and four inches. It is obvious that many feet are gone from the top, whose spreading branches waved in the wind, ages ago, and probably at the height of sixty feet. The superincumbent mass of rock appears to have been an hundred feet thick. The bark is converted into coal. In the great coal field of the north, fossil plants are generally found in a horizontal position or parallel to the strata, but much broken and compressed, with their parts far separated. But large and vigorous plants are sometimes found which appear to have been strong enough to withstand the force of torrents, if such existed, and to have remained in their natural positions. These vertical plants are generally Sigillariæ. The Stigmariæ and the Equisetaceæ do not appear to have been strong enough to have resisted such revolutionary influences. Great numbers of Gymnospermous Phanerogamic plants have been lately discovered in the shales of the mountain limestone group, much broken, and lying in a state of great confusion. Other discoveries of fossil trees have been made in the same quarry, in which the above named plants were found, particularly two immense Coniferæ, and there appears strong reason to believe, that in a square mile of the same deposit, many other ancient relics of early vegetation will be brought to light, and thus induce the belief that these plants are as abundant in these deposits, as in those higher up in the strata. Sometimes the composition of the fossil vegetables is similar to that of the strata in which they lie, and sometimes it is either wholly or partially different, and the variation must be accounted for from the operation of local causes. The composition of the Craigleith fossil, named above, was carbonate of lime 62, carbonate of iron 33, carbon 5, and the specific gravity was 2.87. The composition of the Craigleith tree discovered in 1826 was carbonate of lime 60, oxide of iron 18, alumine 10, carbon 9, loss 3, and several specimens from other places had a similar composition.

A fossil plant from the quarry of Neworth near Newcastle, between the encrinal or mountain limestone and the new red sandstone deposits, was, silica 95, peroxide of iron and alumine 5.

The discoveries of Mr. Witham induce us to believe that plants of the gymnospermous phanerogamic class are much more abundant in the early sedimentary deposits than continental writers have supposed.

We are led to the curious and unexpected conclusion that proper trees, of true ligneous fibre and of great size, existed, even earlier than the bituminous coal, and that the great coally deposits are probably due, in part, to them, as well as to the vascular cryptogamic plants, whose remains are so abundant in these strata.

It is therefore possible that wood may be found, even with the earliest fragmentary rocks, probably with the grauwacke itself.

There can be scarcely a doubt of the vegetable origin of coal, and although the naturalist makes slow advances in disclosing the secrets of this "dark field of existence," yet enough is known to stimulate inquiry, and justify conjecture.

If it is assumed that coal is of vegetable origin, the varieties of quality, and the appearance of mineralized plants, which are more or less frequent in coal measures, may be easily accounted for.

Three external forces are in operation to produce these varieties, which are,

First, the different nature of the superincumbent strata, some of which may insinuate little of their substance in place of the decomposing vegetable matter.

A second is, the effect of great pressure, excluding atmospherical action, and allowing little or no escape of vegetable matter—and

A third, the agency of spontaneous heat, which by causing chemical and other changes in the ligneous fibre, and the concrete juices of the plants, results, in the progress of time, in the formation of those combustible masses, which again vary in quality, proportioned to the resinous and other inherent properties of the plants in their original state.

Some have supposed that anthracite was originally bituminous coal, which time had robbed of its more volatile and more inflammable parts; that by undergoing continual change, the bitumen became assimilated to the carbon. This is possible, but it seems more probable, that it owes its peculiarities to the properties of the vegetable materials from which it had its origin.

The absence of either of the forces acting on a coal bed, would leave the vegetable in a fossil state, e. g. if the amount of heat were insufficient to effect the chemical changes essential to the formation of coal; or if the stratum in which it was imbedded, contained much water holding mineral or metallic substances in solution, which by infiltration might fill up the cavities made by the decaying portions of the plant, its form would thus be preserved, when all its original constituents had ceased to exist.

The subject is one of intense interest, and demands the continued attention of the naturalist. The extended discovery of fossil remains, "those records of past ages," in various parts of Europe, and other quarters of the world, within the last twenty years, has much enlarged the sphere of geological investigation, and proves the necessity of further and more minute examinations "among the dark and pathless repositories of an ancient world."

It may be valuable to the geologist who wishes to examine fossils by the microscope, to have a formula of Mr. Witham's mode of preparing the specimens, for which he acknowledges himself indebted to Mr. Nicoll.

He first cuts a thin slice from the fossil wood, in a direction perpendicular to the length of its fibres. The slice thus obtained must be ground perfectly flat and then polished. The polished surface is to be cemented to a piece of plate, or mirror or glass a little larger than itself, by means of a thin layer of Canada Balsam, applied to the polished surface of the slice, and also to one side of the glass. The slice and the glass must now be laid on a common fire shovel, and gradually heated over a slow fire, to concentrate the balsam. It will require great care to prevent the heat from becoming so great as to throw the balsam into a state of ebullition, for if air bubbles are formed in it, it will be difficult to remove them and they will prevent the complete adhesion of the two surfaces, when applied to each other. The heat of the shovel should never become so great that the fingers may not be held against it without inconvenience. With every precaution, some few bubbles will sometimes make their appearance, but these may be removed by a small stick tapering to a fine point. When the balsam is sufficiently concentrated, and the air bubbles removed, the slice and the glass may be taken from the shovel, and applied to each other. A slight degree of pressure will be necessary to expel the superabundant balsam, and this will be facilitated by gently sliding the one on the other. By this kind of motion, any air which might have got entangled in the balsam will also be removed.

When the whole is cooled to the temperature of the air, and the balsam has become solid, that part of it which adheres to the glass surrounding the slice, should be removed by the point of a pen knife, and by this operation, it will be seen whether the balsam is properly concentrated. If it has entirely lost its sectility, and starts off in flakes before the knife, it will be found that the slice and glass cohere so firmly, that in the subsequent grinding, there will be no risk of their separation. If the balsam is not sufficiently concentrated, it will slide before the knife, and the two bodies will not adhere with sufficient firmness. If the layer of balsam be not too thick, its due concentration may be accomplished in four or five minutes.

The slice must now be ground down to that degree of thinness which will permit its structure to be seen by the microscope. The lapidary will find it advantageous, to fix the glass in a groove made in a small piece of wood. The groove should be a little less deep than the thickness of the glass, and the wood itself should project half an inch beyond each side.

A lapidary will thus find no difficulty in reducing, and polishing any piece of petrified wood to the degree of thinness, sufficient to render its structure visible.

With the hope of exciting the public attention in this country to this very interesting subject, we subjoin a letter from Mr. Witham to the editor, with his reply.

TO PROFESSOR SILLIMAN.

Sir—In perusing your Journal, I perceive you are anxious for the promotion of all branches of science in the various departments, and as it appears to me, that little attention has hitherto been paid in America to the peculiarities of fossil vegetation; I have therefore taken the liberty of sending one or two memoirs, and a short work upon that department of the botanical field. Owing to the great opacity and consequent difficulty of obtaining insight into the internal structure, of fossil vegetables, they have been, until lately, much neglected. You will now perceive that by a new mode of cutting, slicing and grinding, you will be able to obtain the internal structure of any plant that retains its structure. Should you, by your persuasion, be able to set labourers to work in your extensive coal fields, it may lead to comparisons, both curious and highly instructive, and any communications received from you, will be most gratefully received, by, Sir, Your obt. servt. H. Witham.

Lartington, Greta Bridge, Yorkshire, or
14 Great King Street, Edinburgh, April 5.

REPLY.

Yale College, July 11, 1833.

Sir—A few days ago, I had the pleasure of receiving your kind letter of April 5th, with several copies of your two memoirs, for which I beg you to accept my best thanks. They have interested me very much, and I shall give in the Am. Jour. a short notice of your discoveries. In 1830, I republished the first observations which you had then made; and still earlier, those of M. Alex. Brongniart, in the coal of St. Etienne, in France. You have opened a very interesting field of inquiry, and I doubt not that the progress of exploration, in this country, will add to the mass of similar facts. I have just heard, that some huge stems have been recently discovered in one of the anthracite mines of Pennsylvania, but, my information is not precise, although, from the source, I believe it to be authentic.

I have a mass of American anthracite, received not long since, which contains a compressed vegetable branch as large as a human arm; it is distinctly fibrous, like charcoal, and forms a strong contrast with the general lustre and conchoidal fracture of the surrounding substance.

I am led to believe, that (independently of the impressions which are so common in the shales and other attendant rocks,) vegetable structure may be developed in the very mass of coal itself, much more extensively, than has been generally imagined. Our Pennsylvania anthracite, (a stupendous formation,) affords vegetable fibres, in many places, provided the fracture be made, in a particular direction, between the layers of coal; if across, or aslant the layers, no fibres appear, but only a lustrous, conchoidal, or sub-conchoidal fracture. The same is the fact with an immense deposit of bituminous coal upon the banks of the Ohio, between Pittsburgh and Cincinnati. This coal appears to be one entire mass of plants, whose structure is revealed, often with great distinctness, provided the fracture be made, as above stated; otherwise, it has only the usual appearance of glance coal. The same vegetable tissue which is perfectly apparent in one direction, is completely disguised, if the fracture be made, obliquely or directly across the structure, and a similar difference is observed, on fracturing in the same manner, a piece of common charcoal. I shall take the liberty, with a view of exciting attention to the subject in this country, to publish your letter and this hasty reply. Your mode of developing the structure of fossil plants is, I believe, entirely original, as it is certainly most ingenious, and I hope it may be repeated in many countries, until we shall become well acquainted with the botanical character of the plants of the primeval world.

I shall be happy to receive any additional notices with which you may favor me, and I will, in turn, do any thing in my power to promote this interesting research, on this side of the Atlantic.

I remain, sir, very respectfully,

Your most obliged and

very obedient servant,

H. Witham, Esq. B. Silliman.

ART. XV.—*Observations on the Hurricanes and Storms of the West Indies and the coast of the U. States;* by W. C. REDFIELD.*

IT has been found by a careful attention to the progress and phenomena of the more violent storms which have visited the Western Atlantic, that they exhibit certain characteristics of great uniformity. This appears, not only in the determinate course which these storms are found to pursue, but in the direction of wind, and succession of changes which they exhibit while they continue in action. The same general characteristics appear also to pertain, in some degree, to many of the more common variations and vicissitudes of winds and weather, at least in the temperate latitudes. The following points may be considered as established.

1. The storms of greatest severity often originate in the tropical latitudes, and not unfrequently, to the northward or eastward of the West India Islands; in which region they are distinguished by the name of *hurricanes.*

2. These storms cover at the same moment of time, an extent of contiguous surface, the diameter of which may vary in different storms, from one to five hundred miles, and in some cases they have been much more extensive. They act with diminished violence towards the exterior, and with increased energy towards the interior, of the space which they occupy.

3. While in the tropical latitudes, or south of the parallel of 30°, these storms pursue their course or are *drifted* towards the west, on a track which inclines gradually to the northward, till it approaches the latitude of 30°. In the vicinity of this parallel, their course is changed somewhat abruptly to the northward and eastward, and the track continues to incline gradually to the east, towards which point, after leaving the lower latitudes, they are found to advance with an accelerated velocity.

The rate at which these storms are found thus to advance in their course, varies much in different cases, but may be estimated at from twelve to thirty miles an hour. The extent to which their course is finally pursued, remains unknown; but it is probable, that as they

* From Blunt's American Coast Pilot, twelfth edition.—Mr. Redfield's paper on this subject (see Vol. xx. pa. 17 of this Journal) having been received with no small interest,—the revised view which he has prepared cannot be unacceptable.

proceed, they become gradually extended in their dimensions, and weakened in their action, till they cease to command any peculiar notice. One of the hurricanes of August 1830, has been traced in its daily progress, from near the Caribbee Islands, to the coast of Florida, and the Carolinas, and from thence to the banks of Newfoundland; *a distance of more than three thousand miles*, which was passed over by the storm in about six days. The duration of the most violent portion of this gale, at the different points over which it passed, was about twelve hours, but its entire duration was in many places, more than twice that period. Another hurricane which occured in the same month, passed from near the Windward islands, on a more eastern but similar route, and has also been traced in its daily stages by means of the journals and reports of voyagers, *near two thousand five hundred miles.* It was in this storm, that the Russian Corvette Kensington, Captain Ramsey, suffered so severely. The hurricane of August 1831, which desolated the island of Barbadoes on the tenth of that month, the daily progress of which has also been ascertained, passed in nearly a direct course to the northern shores of the Gulf of Mexico and New Orleans, where it arrived on the 16th of the same month, having passed over a distance of *twenty three hundred statute miles* in six days after leaving Barbadoes. Many cases of like character might be adduced.

4. The *duration* of the storm at any place within its track, depends upon its extent and the rate of velocity at which it moves, as these circumstances are found to determine the time which is required for the storm to pass over any given locality falling within its route. Storms of smaller extent or dimensions, are usually found to move from one place to another with greater rapidity than larger storms.

5. The direction and strength of the wind exhibited by a storm, over the greater portion of its track, are found *not to be in the direction of its progress.* The rate or velocity of this progress would indeed be insufficient to produce any violent effect.

6. In the lower latitudes while drifting to the westward, the direction of the wind at the commencement, or under the most advanced portion of these storms, is from a *northern* quarter, usually from north east to north west; and during the latter part of the gale, it blows from a *southern* quarter of the horizon, at all places where the whole gale is experienced.

7. After reaching the more northern latitudes, and while pursuing their course to the northward and eastward, these storms commence with the wind from an eastern or southern quarter, and terminate with the wind from a western quarter, as will appear more distinctly under the three following heads;—the latter portion of the storm being usually attended with broken or clear weather.

8. On the outer portion of the track, north of the parallel of 30°, or within that portion of it which lies farthest from the American coast, these storms exhibit at their commencement, a *southerly* wind which, as the storm comes over, *veers gradually to the westward*, in which quarter it is found to terminate.

9. In the same latitudes, but along the *central portions of the track* the first force of the wind, is from a point near *to south-east*, but after blowing for a certain period, it *changes suddenly*, and usually after a short intermission, to a point nearly or directly opposite to that from which it has previously been blowing, from which opposite quarter it blows with equal violence till the storm has passed over or has abated. This sudden change of a south-easterly wind to an opposite direction, *does not occur towards either margin of the storm's track*, but only on its more central portion, and takes effect in regular progression along this central part of the route, from the *south-west* towards the *north-east*, in an order of time, which is exactly coincident with the progress of the storm in the same direction. It is under this portion of the storm, that we notice the greatest fall of the barometer, and the mercury usually begins to rise a short time previous to the change of wind. In this part of the track, the storm is known as a *south-easter*, and is usually attended with rain previous to the change of wind, and perhaps for a short time after.

10. On that portion of the track which is *nearest* the American coast, or which is farthest inland if the storm reaches the continent, the wind commences from a more eastern or north-eastern point of the horizon, and afterwards veers more or less gradually, by north, to a north-western or westerly quarter, where it finally terminates. Here also the first part of the storm is usually, but not always attended with rain, and its latter or western portion with fair weather. The first or foul weather portion of the storm, is on this part of its track, recognized as a *north-easter*.

It should be noted, however, that near the latitude of 30° and on the shores of Carolina, where the storm enters obliquely upon the coast, while its track is rapidly changing from a northwardly to an eastwardly direction, the wind on the central track of the storm will commence from an eastern or north-eastern point of the compass, and will gradually become south-easterly as the storm approaches its height.

11. A full and just consideration of the facts which have been stated, will show conclusively that the portion of the atmosphere which composes for the time being the great body of the storm, whirls or blows in a horizontal circuit, around a vertical or somewhat inclined axis of rotation which is carried onward with the storm; that the course or direction of this circuit of rotation is from *right to left;* and that the storm operates in the same manner, and exhibits the same general characteristics, as a tornado or whirlwind of smaller dimensions; the chief difference being in the magnitude of the scale of operation.* This view of the subject, when fully comprehended, affords a satisfactory solution of the otherwise inexplicable phenomena of storms; and will also be found to accord entirely with the fact, which has been previously stated, that in the phases or changes which pertain to a storm, the wind, on one margin of its track, veers in seaman's phrase *with the sun*, or from *left to right*, while under the opposite margin of the same storm it veers *against the sun*, or from *right to left;* for this peculiarity necessarily attends the progress of any whirlwind which operates horizontally.

12. The Barometer, whether in the higher or lower latitudes, always sinks while under the first portion or moiety of the storm on every part of its track, excepting perhaps, its extreme northern margin, and thus often affords us the earliest and surest indication of the approaching tempest. The mercury in the Barometer always rises again during the passage of the last portion of the gale, and commonly attains the maximum of its elevation on the entire departure of the storm.

The great value of the Barometer to navigators is becoming well understood, and its practical utility might be greatly increased by hourly entries of the precise height of the mercurial column in a table prepared for the purpose. Its movements unless carefully recorded, often escape notice or recollection; which may easily happen at those times when a distinct knowledge of its latest variations might prove to be of the greatest importance.

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* It is to be understood that the diameter of the whirlwind which constitutes the storm is commensurate with the width of the track over which the storm passes.

In the foregoing statements our design has been to designate in a summary manner the principal movements which, in these regions at least, constitute a storm; and we do not attempt to notice the various irregularities, and subordinate or incidental movements and phenomena of the atmosphere, with which a storm may chance to be connected, or which may necessarily result from such violent movements in a fluid which is so tenuous and elastic in its character. It may be remarked in general, that the most active or violent storms are usually the most regular and uniform in the development of those characteristic movements which we have already described. It is also probable, that the vortex or rotative axis, of a violent gale or hurricane, oscillates in its course with considerable rapidity, in a moving circuit of moderate extent, near the centre of the hurricane; and such an eccentric movement of the vortex may, for aught we know, be essential to the continued activity or force of the hurricane. Such a movement will fully account for the violent *flaws* or *gusts* of wind, and the intervening *lulls* or remissions, which are so often experienced towards the heart of a storm or hurricane, when in open sea; but of its existence we have no positive evidence.

It frequently happens that a storm during the first part of its progress over a given point, fails to take effect upon the surface, while it exhibits its full activity at a greater altitude. This commonly happens when this portion of the storm arrives from, or has recently blown over a more elevated country, or is passing or blowing from the land to the sea. On land the most violent effects are usually felt from those storms which enter and blow directly from the open ocean upon the shores of an island or continent. Upon the latter, under such circumstances, the *first* part of the gale is usually the most severe, and that coast of an island upon which a storm first enters, or blows, also suffers most from the early part of the gale, but its later or receding part, often acts with the greatest fury upon the opposite side of the island, which had previously derived some degree of shelter from the intermediate elevations and other obstacles opposed to the force of the wind, the benefit of which is now lost by its counter direction from the open ocean. Owing to similar causes, the force of the storm is sometimes very unequal at different places, situated in nearly the same part of its track, and such inequality, as we have before intimated, necessarily pertains to two places one of which is near the centre and the other towards the margin of the route.

Of the multitude of facts by which this part of the subject might be illustrated, we will only state, that in the late hurricane at Barbadoes, (that of August 1831) the trees near the northern coast of that island, lay from N. N. W. to S. S. E. having been prostrated by a northerly wind in the earlier part of the storm, while in the interior and some other parts of the island, they were found to lie from south to north, having fallen in the later period of the gale.—That after the same hurricane, advices which were received from the islands of St. Croix and Porto Rico, (which lay near the northern margin of its track) stated that no hurricane had been experienced at these islands; but it afterwards appeared that some portions of these islands had suffered damage from this hurricane in the night of the 12th to 13th of August, two days after it passed over the island of Barbadoes.—That the sea islands which border the coast of Georgia and the Carolinas, are known to suffer greatly from these tempests, while little or no injury is sustained in the interior at the distance of a few miles from the coast. One of the most striking characteristics of these storms, is the *heavy swell* which in open sea is often known to extend itself on both sides of the track, entirely beyond the range of the gale by which it was produced. The last hurricane to which we have alluded, threw its swell with tremendous force upon the northern shores of Jamaica, having passed to the northward of that island.

A variety of deductions may be drawn from the general facts which we have stated, some of which, are deeply interesting to the philosopher and votary of science. For ourselves, we disclaim any bondage to existing theories in meteorology; and shall on the present occasion, only proceed to notice a few of the more practical inferences which, to navigators and others may, perhaps, be of no doubtful utility.

1. A vessel bound to the eastward between the latitudes of 32° and 45° in the western part of the Atlantic, on being overtaken by a gale which commences blowing from any point to the eastward of S. E. or E. S. E. may avoid some portion of its violence, by putting her head to the northward, and when the gale has veered sufficiently in the same direction, may safely resume her course. But by standing to the southward under like circumstances, she will probably fall into the heart of the storm.

2. In the same region, vessels, on taking a gale from S. E. or points near thereto, will probably soon find themselves in the heart of the storm, and after its first fury is spent, may expect its recurrence from the opposite quarter. The most promising mode of mitigating its vi-

olence, and at the same time shortening its duration, is to stand to the southward upon the wind, as long as may be necessary or possible; and if the movement succeeds, the wind will gradually head you off in the same direction. If it becomes necessary to heave too, put your head to the southward, and, if the wind does not veer, be prepared for a blast from the north-west.

3. In the same latitudes, a vessel scudding in a gale with the wind at east or north-east, shortens its duration. On the contrary, a vessel scudding before a south-westerly or westerly gale, will thereby increase its duration.

4. A vessel which is pursuing her course to the westward or south-westward, in this part of the Atlantic, meets the storms in their course, and thereby shortens the periods of their occurrence; and will encounter more gales in an equal number of days, than if stationary, or sailing in a different direction.

5. On the other hand, vessels while sailing to the eastward or north-eastward, or in the course of the storms, will lengthen the periods between their occurrence, and consequently experience them less frequently than vessels sailing on a different course. The difference of exposure which results from these opposite courses, on the American coast, may in most cases be estimated as nearly two to one.

6. The hazard from casualties, and of consequence the value of insurance, is enhanced or diminished by the direction of the passage, as shown under the last two heads.

7. As the ordinary routine of the winds and weather in these latitudes, often corresponds to the phases which are exhibited by the storms as before described, a correct opinion, founded upon this resemblance, can often be formed of the approaching changes of wind and weather, which may be highly useful to the observing navigator.

8. A due consideration of the facts which have been stated, particularly those under our twelfth head, will inspire additional confidence in the indications of the *barometer*, and these ought not to be neglected, even should the fall of the mercury be unattended by any appearances of violence in the weather, as the other side of the gale will be pretty sure to take effect, and often in a manner so sudden and violent as to more than compensate for its previous forbearance. Not the least reliance, however, should be placed upon the prognostics, which are usually attached to the scale of the barometer, such as *Set-Fair*, *Fair*, *Change*, *Rain*, *&c.* as in this region, at least, they serve no other purpose than to bring this valuable instrument into discredit.

It is the mere rising and falling of the mercury, which chiefly deserves attention, and not its conformity to a particular point in the scale of elevation.

9. These practical inferences apply in terms, chiefly to storms which have passed to the northward of the 30th degree of latitude on the American coast, but with the necessary modification as to the point of the compass, which results from the westerly course pursued by the storm while in the lower latitudes, are for the most part equally applicable to the storms and hurricanes which occur in the West Indies, and south of the parallel of 30°. As the marked occurrence of tempestuous weather is here less frequent, it may be sufficient to notice that the point of direction, in cases which are otherwise analogous, is in the West Indian seas, about ten or twelve points of the compass *more to the left* than on the coast of the United States in the latitude of New-York.

Vicissitudes of winds and weather on this coast which do not conform to the foregoing specifications, are more frequent in April, May, and June, than in other months. Easterly or southerly winds under which the barometer rises, or maintains its elevation, are not of a gyratory or stormy character; but such winds frequently terminate in the falling of the barometer and the usual phenomena of an easterly storm.

The typhoons and storms of the China sea and eastern coast of Asia, appear to be similar in character to the hurricanes of the West Indies and the storms of this coast, when prevailing in the same latitudes. There is reason to believe that the great circuits of wind, of which the trade winds form an integral part, are nearly uniform in all the great oceanic basins; and that the *course* of these circuits and of the stormy gyrations which they may contain, is, in the southern hemisphere, in a *counter-direction* to those north of the equator, producing a corresponding difference in the general phases of storms and winds in the two hemispheres.

Art. XVI.—*Summary Statements of some of the leading Facts in Meteorology;* by W. C. Redfield.

To the Editor of the American Journal of Science.

Dear Sir.—In the observations on the storms of the West Indies, and the coast of the United States, which I have lately furnished for the American Coast Pilot, you will find a condensed and more explicit statement of the result of the investigations which were the subject of my former article on the storms of the American coast,* than that article presents.

In the attempt to ascertain and describe the physical characteristics of these tempests, I have been under the influence of no preconceived opinions, or theories, except such as commonly prevail among the reading public. My sole object has been to arrive at truth. Nor did I contemplate, until a late period in the inquiry, the task of placing these results before the public. However imperfectly this task has been executed, a sufficient apology for attempting it may, perhaps, be found, in the almost total absence of information on this subject, in books of science; as may be seen by referring to the articles, Hurricane, &c. in the best Encyclopædias. Dr. Franklin has indeed elicited the fact, that some storms on this coast approach from the south-west, while exhibiting the wind in a contrary direction, and this for a long period seems to have been the extent of our knowledge.

To the same philosopher we were first indebted for proofs of the identity of whirlwinds with waterspouts. The labors of an able cotemporary, (Professor Mitchell,) appear also to be entitled to respectful notice, so far, at least, as they relate to the physical character of thunder storms.

It is with some hesitation, that I send you the following paragraphs from the forthcoming American edition of a little compendium, which is entitled, "*A Million of Facts;*" the meteorological portion of which, has fallen under my supervision. Some of the statements in these paragraphs now appear for the first time in a distinct form, although sufficient evidence for their support, may be found recorded. They comprise but a part of that range of investigation which seems necessary to be pursued, in order to place meteorology upon a just footing among the sciences.

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* Journal of Science, Vol. xx.—also, Vol. xxi. p. 191—193.

I am aware that this method of bringing forward truths, or propositions, in natural science, is liable to objections; but I have thought it better to incite the attention of others to the facts and *physics* of meteorology, by means of such brief statements, rather than to attempt a systematic demonstration of this extensive and interesting subject, under circumstances which, on my part, seem to preclude such an undertaking.

The favorite and hitherto prevailing theory, or hypothesis, is that which makes equatorial heat and rarefaction, to be the principal cause, the grand *primum mobile,* of winds; and which assigns local rarefaction as the immediate cause of great storms. If this theory should seem to be invalidated in any degree, by these statements, or by any that have been previously made, the fault is not mine. Facts in nature are strangely unaccommodating, in relation to some opinions, and modes of thinking which the writer, in common with your readers, has been accustomed to cherish.

General view of the Atmosphere.

The superficial extent of the atmosphere at its lower surface, is equal to about 200,000,000 of square miles. Its altitude, if reckoned at the uniform density of its lower surface, or in other words, according to its actual quantity, is equal to a little more than five miles. Considered, therefore, as a fluid stratum resting upon the earth, the horizontal or superficial extent of the atmosphere is to its altitude or vertical dimensions, in the proportion of near 40,000,000 to 1; which shows its relative thickness to be less than that of a sheet of paper, when compared with its surface, a fact that well deserves consideration in any physical estimate of its winds and currents.

Temperature of Elevation.

Elevation above the level of the sea, or the general level of a country, makes a regular variation in temperature; the first 300 feet, it is supposed, causes a difference of a degree. After ascending 300 feet, we are told, the thermometer falls a degree at 295 feet, then at 277, 252, 223, and at 192 feet; so that at 1539 feet of elevation, the thermometer will fall six degrees in a general way; but 300 feet per degree is the common rule. On these principles, the limit of perpetual congelation has been theoretically calculated: it is made 15000 feet at the equator; and from that to 13000 between the tropics; and from 9000 to 4000 between latitude 40° and 59°.

It has been found, however, that the above rule is subject to great variations, owing probably to the physical character and temperature of the atmospheric currents which prevail in different regions and at different altitudes. Warmer strata or currents are often found resting upon, or interposed between, those of a lower temperature. On the Himalaya mountains between the latitudes of 28° and 34° north, the region of vegetation has been found to extend many thousand feet above the supposed line of perpetual congelation assigned to those latitudes. It is also remarkable that the line of perpetual snow is found at a much greater altitude on the *northern* side of these mountains than on the southern side in a lower latitude. These facts, with others which are obtaining notice, will cause a revision of the hitherto prevailing theories in meteorology.

Of Trade winds and Monsoons, and their circuitous character.

The trade winds, in both hemispheres, on approaching the western borders of the great oceans, become deflected in their course, and passing into higher latitudes in the form of south-west and north-west winds, they become identified with the prevailing westerly winds in these latitudes. On the eastern borders of these oceans the air returns towards the equator in the form of northerly or southerly winds, which on crossing their respective parallels of 30°, become merged in the easterly trades, on both sides the equator; the locality, as well as activity, of these aerial circuits, being affected more or less with the change of seasons. This appears to be the great law of circulation in our atmosphere; and it is chiefly to the physical character and course of the winds in different portions of these great circuits, that the peculiarities of temperature and climate which pertain to certain countries lying in the same latitudes, but on opposite sides of the same ocean, are to be referred; as also the remarkable absence or predominance of *rain* in certain countries and latitudes. The Monsoons of the Indian seas are but a modification of the same system of circulation. Counter circuits are sometimes formed in subordinate basins, and in high latitudes; the irregularities usually becoming greater in proportion as we recede from the equatorial regions.

The north-west and south-west Monsoons, which have been erroneously ascribed to the effects of local or continental rarefaction, are found to extend themselves far to the eastward of the Asiatic continent and islands, and even to the central portions of the great Pacific ocean.

The dry current of the north-east Monsoon, on approaching the equator, becomes deflected and checked in its course, and crossing the equator, returns again to the eastward, in the southern latitudes, in the form of the wet north-west Monsoon. On the other hand, the dry south-east Monsoon which prevails in the opposite season south of the equator, becomes deflected in the same manner, in the equatorial region, and returns to the eastward north of the equator in the character of the south-west Monsoon.

In Ceylon, (lat. 8° north) the north-east Monsoon, with a temperature of 68° Fahrenheit, has a dryness of 75 hygrometric degrees. The opposite Monsoon, from the south-west at 82° Fahrenheit, is so damp as to indicate but 30°.

Of General Winds and atmospheric phenomena.

As the winds, over a breadth of 60 degrees, blow with slight interruption, from east to west; so in the northern and southern hemispheres the atmospheric equilibrium demands that the prevailing winds should be from west to east, and therefore, for the most part, westerly winds prevail for two thirds of the year, and they enable ships which sail to the West Indies by the trade winds to return to the East by first ascending to the latitude of 40° or 45°.

In almost every country, as well as in every sea, the wind is more or less predominant in a particular direction.

From the average rate of sailing of ships during long voyages through various seas, as in the China trade, and from other data, it is estimated that the average velocity of the wind, near the surface of the ocean, is equal to eighteen miles an hour throughout the year.

Notwithstanding these general and determinate horizontal movements, the equal distribution of the atmosphere over the surface of the globe, which results from gravitation, tends to prevent any very rapid or violent motion in any specific direction, and consequently to prevent violent and destructive winds. But owing to the tendency of all fluid matter to run in whirls, or circuits, when subject to the influence of unequal or opposing forces, a rotative movement of unmeasured violence is sometimes produced. This peculiar movement which in its most active state is sometimes distinguished by the name of tornado or hurricane, assumes every possible variety of position, appearance, velocity and extent; and is the only *known cause* of violent and destructive winds or tempests.

The various phenomena and effects which result from this cause, are usually considered as distinct meteors, and are variously named in different countries, according to their sensible appearances, intensity, extent and duration. Such stormy meteors are distinguished by the following among other names, which are often applied in an indeterminate manner and sometimes to the same, or modifications of the same phenomena.

Class 1st. *Aerial meteors or phenomena constituted by whirls or violent movements of limited extent.*

Flaw	*Turbonado*
Whirl	*Tourbillon*
Gust	Tornado
Rush of wind	Bursting of a Waterspout
Whirlwind	Falling of a Waterspout
Helm or Helm wind	Bursting of a cloud
Spout	Squall
Waterspout	Thunderstorm
Sand spout	Hailstorm
Sand pillar	Sandwind
Fire pillar	Samiel
Turbo	Simoom

Class 2d. *Whirlwind-storms or violent movements of greatly increased extent.*

Gale	Norther (Mexico.)
Blow	Sirocco
Storm	Hurricane
Pamperro (in La Plata.)	Typhoon, or *Tau-fung*, &c.

Names of general or periodical winds of the nature of currents.

Trade Winds	Etesian Winds
Monsoons	Harmattan, &c.

The Samiel is described as a hot noxious wind which sometimes passes over the sandy deserts of Arabia and Africa. It passes in narrow currents lasting only a few minutes. The coming of it is indicated by a thick haze in the horizon, and travellers, if they have time, throw themselves on their faces, till it has passed.

The Sirocco is a blighting hot wind which prevails in Italy, &c., about April.

The Harmattan is an east wind of great dryness, which visits the western coast of Africa in the low latitudes, in the months of January, February and March. It is probably the true trade wind, which ordinarily does not act in these regions as a surface wind, but passes in a higher stratum.

The Helm wind is a violent whirlwind, peculiar to the western side of the Cross Fell mountain in Cumberland; and it occurs only during an easterly wind. Whirlwinds of the same character are not uncommon in other regions where obstructions are presented to the regular wind.

Whirlwinds of great extent always act horizontally; those of small dimensions act either horizontally or vertically, or at any intermediate angle of inclination. Many of this smaller class of whirlwinds occur in the atmosphere which do not reach the surface of the earth, and can be recognised only by the sensible phenomena which they produce. The most obvious of these characteristics are, the cloudy pipe or pillar called the waterspout; thick masses of turbulent clouds; thunder and lightning; often repeated or continuous thunder, or lightning; a continued roar in the atmosphere resembling the noise of a loaded waggon driven rapidly on frozen ground, or in some cases like the continued discharge of artillery and small arms; hail of uncommon size in a circumscribed locality or running in veins; large drops of rain; a deluge of rain falling in a small compass; the falling of sand, ashes, small fish, reptiles, and other matters previously taken from the surface; &c. &c.

Whirlwinds of whatever form or extent, and however active or violent their revolutions, move forward only with the velocity of the more regular wind by which they are impelled.

Showers of frogs, fishes, &c. arise from waterspouts, or spiral eddies, [whirls] by which small portions of the waves of the sea and ponds of water, (in a state of division,) with their contents, are forced to an elevation; and thus being transported to a distance, and there falling, produce these strange precipitations.

In clear, calm, and sultry weather, whirlwinds have been excited by fires, burning simultaneously in a large circle, and have exhibited violent and continued electric explosions, and the peculiar phenomenon of the *turbo* or whirling pillar, with other of the forementioned characteristics.

Volcanic eruptions often excite whirlwinds of great altitude, and of most violent character.

Thunder storms appear to be whirlwinds, gyrating, in ordinary cases, on a horizontal axis of rotation. The wind which they exhibit often blows with a velocity greatly exceeding the progress of the thunder storm, as is the case with other whirlwind storms.

The presence of warm and humid air is supposed to be necessary to the production of violent electrical phenomena, such as thunder and lightning. The latter phenomenon is generally caused by the commingling of air, of different temperature and condition.

Hurricanes are the most violent and destructive storms of the Atlantic ocean. They are of the whirlwind character, and the direction of their rotation in the North Atlantic is from right to left, horizontally. In the latitudes of the West Indies, their general course or *drift* is towards the west inclining, however, gradually to the northward. About the parallel of 30° their progress to the westward ceases, and passing into higher latitudes they pursue an easterly course, on a track nearly parallel to the American coast.

In the West Indies, hurricanes begin to blow from a northern quarter of the horizon, and thence changing to the west and round to a southern quarter, and then their fury is over. These phases however will be found somewhat different towards the two opposite margins of a storm's track, and also in positions which are sheltered in some directions from the action of the storm by elevated land. On the coast of the United States these storms commence blowing from an eastern quarter, which corresponds to the change in their line of progress, and exhibiting changes of a like character, they terminate with fair weather from a western quarter.

The direction of the wind and the progressive changes in great storms are found to accord with the locality or position of the storm in the great oceanic circuit of wind or atmospheric current. In the southern hemisphere the course and changes of such storms appear to be *counter* to those in the northern hemisphere. Thus storms in the northern latitudes in certain circumstances blow first from the *south-east* and then change to the north-west; while in New-Holland, storms in like circumstances blow first from *north-west* and then change to south-east.

Elevated Currents, and Stratification of the Atmosphere.

Little is known of the direction of the wind upon the highest mountains, but in Peru and at the Sandwich Islands, at the height of about eighteen thousand feet, it has been found to be fresh from the south west, and on the peak of Teneriffe, about ten thousand feet above the sea, a strong wind blows from the west.

Volcanic ashes when carried into the higher regions of the atmosphere are usually wafted to the eastward. Upon an eruption of Mount Vesuvius in 1631, a shower of ashes fell upon the coast of continental Greece, and also at one hundred leagues distance towards the coast of Syria. On the eruption at St. Vincent in 1812, ashes were deposited at Barbadoes, sixty or seventy miles eastward, and also on the decks of vessels one hundred miles still farther east, while the trade wind at the surface was blowing in its usual direction. In the same year ashes fell upon the deck of a British packet bound to Brazil, when distant nearly one thousand miles from the nearest land.

Nearly all the sensible phenomena of the atmosphere occur below the height of eighteen thousand feet, and generally much nearer to the earth's surface. Owing to the retardation of the surface winds and to other causes, the currents in the lower atmosphere run upon each other in horizontal strata, which differ much in temperature and hygrometrical condition, as well as in the direction and velocity of movement. It is chiefly to the condition of these strata and their influence upon each other that the formation of clouds and rain is to be ascribed.

Of the Barometer.

The fluctuations of the barometer appear to be owing to different causes, and may be classed under the three following heads:

1. The regular semi-diurnal variation, which, in the tropical latitudes, is at its maximum about 10 A. M., and at its minimum about 3 P. M. At New York it is nearly the same, but at Edinburgh the effect is reversed, the minimum being at 10 and the maximum at 3 o'clock. It appears to indicate a system of atmospheric tides, resulting from the rotation of the earth and its connexion with the solar system.

2. The variations resulting from the mechanical action of circuitous winds and the larger atmospheric eddies; including not only the storms but a large portion of the winds in the higher latitudes. During the passage of these eddies or storms over the place of observation, the barometer sinks while under their first or most advanced portions, and rises as they pass over or recede. The most prominent variations of the barometer are of this character.

3. The general movement or oscillation of an extensive region of atmosphere in the higher latitudes, under the alternately predominating influence of centrifugal action towards the equator, and gravitation towards the poles. These extensive oscillations are infrequent, and nearly uniform in their effect on the barometer over an extensive region of country at nearly the same time.

The highest range in the polar regions observed by Capt. Parry, was 30.86 inches. During a violent storm or hurricane the barometer has sometimes fallen below 28 inches.

The fall of the barometer has no necessary and immediate connexion with rain, although storms of wind which affect the barometer are often attended by rain. It appears from the observations of the Marquis Poleni, that in 1175 instances of falls of rain, the barometer sunk only 758 times, being 645 to 1000. In the United States, the most copious rains sometimes fall during an unusual elevation of the barometer.

Currents and Temperature of the Ocean.

The conformity of the oceanic movements to those of the atmosphere, with other analogies in the two fluids, will, perhaps, justify a few notices, which do not belong to the department of Meteorology.

The most remarkable currents in the ocean are those which continually follow the same direction. These usually follow the course of the great circuits of wind in every ocean, and besides, have a general connexion with each other, so that much of the oceanic fluid is constantly passing from one basin to another.

The waters of the north Atlantic perform a constant circuit in the parallels between the equator and the banks of Newfoundland, of which circuit the concentrated current of the gulf stream forms a conspicuous part, and in the center of this circuit is situated the great field of floating sea-weed called the grassy sea. Its strength is perhaps aided by the current which passes from the Indian Ocean round the Cape of Good Hope, through the south Atlantic, and which, joining the equatorial current, passes to the north west into the Caribbean sea.

In the north Atlantic a counter circuit is also formed, which passes near the British islands and the coast of Norway, and enters the polar basin, from whence it returns under the name of the polar current, and passing down the coasts of Greenland and Labrador, carries with it, at certain seasons, the floating ice of the polar regions.

The fruit of trees which belong to the American torrid zone, is every year deposited on the western coasts of Ireland and Norway; and on the shores of the Hebrides are collected seeds of several plants, the growth of Jamaica, Cuba, and the neighboring continent. The most striking circumstance, perhaps, is that of the wreck of an English vessel, burnt near Jamaica, having been found on the coast of Scotland.

The general features of the currents in the north and south Pacific resemble those in the Atlantic, except that they are obstructed by numerous islands. A Japanese junk, which had been disabled on that coast, has recently been drifted to the Sandwich Islands; and pieces of wreck and other articles from the China sea, are often found by the whale ships in the northern Pacific.

The existence of *under currents*, different from those on the surface, is highly probable and is supported by the analogy of the atmospheric currents, which traverse immense distances in distinct horizontal strata; but their existence is not distinctly proved except by the drift of the icebergs, which are brought into the margin of the gulf stream, during the spring and summer, by the polar current, which then disappears, and from its greater density, probably becomes an inferior current, passing to the lower latitudes. From the great depth of the icebergs, it probably continues to act upon them after they arrive within the influence of the warmer current of the gulf stream.

An under current is also supposed to exist in the straits of Gibraltar, where there is a constant influx from the Atlantic through the strait; as the wreck of a vessel which was sunk on the Mediterranean side of the strait, is said to have risen again in the Atlantic.

The existence of under currents is further confirmed by the increased temperature of the water at certain depths in some parts of the ocean, which, as in the case of the atmosphere, being contrary to known tendencies, seems to prove the interposition of strata of different temperatures, by the action of dissimilar currents.

It is common to ascribe the currents of the ocean wholly to the action of the winds; but, as the waters of the ocean are subject to the same impulses as the superincumbent atmosphere, it is probable that the principal movements of both fluids have their origin in the same causes.

Water being a bad conductor of heat, the temperature of the sea changes much less suddenly than that of the atmosphere, and is by no means subject to such extremes as the latter. The temperature of the sea never, in any latitude, exceeds 86 or 87 degrees of Fahrenheit.

The existence of banks or shallows has a local effect in diminishing the temperature of the ocean, but the great agents in modifying it are currents, which mingle together, or, rather, change the locality of waters of different regions. Thus, the gulf stream, as it is called, which sets into the gulf of Mexico from the equatorial regions, is much warmer than the neighboring parts of the sea; the current of Chili is just the reverse, being in its progress from the higher to the equâtorial latitudes, where it passes into the wide Pacific, and carries the warmth which is subsequently acquired, again to the higher latitudes.

Of Tides.

The influence of the moon in producing the tides, is supposed to be greater than that of the sun, and evidently governs the time of high water. As the moon crosses the meridian of a place about every twenty-four hours and fifty minutes, the sea, in most parts of the world, ebbs and flows twice in that space of time. In large portions of the Pacific Ocean, however, as well as in certain other localities, the tides are exempt from the lunar influence. At Tahiti and the Georgian group, near the center of the Pacific Ocean, the tide rises but one or two feet, and it is high water at noon and midnight throughout the year, and this too, in the very region where the established theory would lead us to expect the lunar tides to be the most regular and powerful. The tides upon the coast of Guatemala, in the Caribbean sea, afford a similar exception, while on the opposite coast at Panama the tides of the Pacific rise to the height of twenty feet. These facts serve to show that the *modus operandi* of the causes which produce tides, is not thoroughly understood.*

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* Does not the course of the great semi-diurnal tide wave, in each of the great oceans, mainly correspond to the great circuits of oceanic and atmospheric currents, *moving from west to east in the higher latitudes?* Mr. Lubbock, who is engaged in an elaborate investigation of the facts in relation to the tides, can furnish us the means of solving this question. If the affirmative be true, these several movements would seem to originate in a common impulse or tendency.

Of Climate, as connected with the Atmospheric and Oceanic Currents.

The term *climate*, expresses that particular combination of temperature and moisture, which exists in the atmosphere of any greater or less extent of country.

The temperature of the sea has an effect upon the winds which pass over it, and this temperature being more equable than that of the land, tends to equalize the temperature of an island or a maritime country. The temperature of the ocean, contiguous to any country, also depends much upon the position of that country in relation to the great oceanic currents.

It is the character of the prevailing winds which chiefly, and more immediately, affects the climate of any country situate without the tropics. The currents of the atmosphere, like those of the ocean, form a system of continued circuits, by which the accumulated warmth of one region is often conveyed to another, and by this means important modifications of climate are produced.

Mountains also affect climate in more ways than one. By causing the condensation of aqueous vapor they occasion copious rains. They also afford shelter from winds; and by their position modify or control the currents of the lower atmosphere, and sometimes occasion great diversities in the climate of countries and places near to each other.

The climate of the United States and Canada strongly illustrates the influence of these causes. The tropical current or trade wind, being deflected by the Mexican elevations, enters the great basin of the Mississippi and sweeps freely over the extensive country lying east of the Rocky mountains. Here, by change of latitude, the diurnal motion of the surface becomes less than that of the superincumbent fluid, which therefore necessarily assumes the form of westerly winds, and passes back to the Atlantic, to be in due time again merged in the north-easterly trades. When this tropical current keeps sole possession of the surface, which it often does for days together, extraordinary heat prevails, extending frequently through the entire basin of the St. Lawrence, and sometimes raising the thermometer on the borders of that river, at Montreal, to 98 degrees of Fahrenheit. But in winter, when the locality of this great circuit is changed to a more southern region, and when its current is entirely displaced from the surface of the great interior plateau by the cold winds of the interior, which come down from the

Rocky mountains, or from high latitudes on a course parallel to those mountains, this region becomes subject to all the rigors of a Siberian winter.

The climate of China bears a close resemblance to that of the United States, and the continental and oceanic positions of the two countries are equally analogous. Both countries are subject to the extremes of heat and cold above most others in the same latitudes.

The character of the polar current, and the great quantities of ice which it brings to the north-east coast of America, is supposed to influence the climate of that coast, particularly in the spring months. At Newfoundland, which is in the latitude of Paris, late in the month of June, 1831, the bays and harbors were full of ice.

Of Deserts.

The atmosphere is capable of absorbing moisture in proportion to its temperature, and a current of air passing from a colder to a warmer region has therefore a constantly increasing capacity for moisture. This peculiarity necessarily pertains to one portion of each of the great natural circuits of wind, or atmospheric current, in both hemispheres. The necessary consequence is a great scarcity of rain in the regions falling under this portion of the current, and hence those arid deserts which occupy so large a portion of the otherwise most fruitful latitudes.

On examining the map of the world, it may be seen that this scarcity of rain prevails chiefly, in countries lying upon the eastern borders of the great oceans, and of their atmospheric circuits, and between the 18th and 32d parallels of latitude. On the western borders of the Atlantic, in both the Americas, where the aerial current is passing from the lower to higher latitudes, there are abundant supplies of rain. The same is true also of China and the eastern coast of Africa, and also of the western shores of the Pacific generally, except as the effect is modified by the misplaced counter current of the Monsoons. But not so on the eastern shores of these oceans, where the atmosphere which forms the extra-tropical winds, falling in again towards the equator, presents a constant demand for additional moisture, and parches and desolates extensive regions of country.

In the atmospheric basin of the North Atlantic, we have the most striking exhibition of this effect in the great African desert of Sahara. Continuing our survey on the same parallels, we have also the great deserts of Lybia, Egypt, and Arabia, subject, for the greater part, to the same course of the atmospheric currents, and exhibiting the same disastrous effects. In the basin of the south Atlantic we have, on its eastern shore, in South Africa, a barren desert, extending across the same latitudes, and spreading from the shore to the mountains. Over this region prevails a constant southerly wind, being that section of the great southern circuit which is pursuing its way to the tropics. On the eastern shore of the South Pacific, in the same latitudes, we have also the desert of Atacama, and the coast of Peru, with a corresponding section of southerly or circuit wind, a coast which is known to be proverbial for the total absence of rain.

Additional Observations on Winds.

Owing to the circuitous character of most winds, the temperature of the wind frequently does not conform to the supposed temperature of the quarter from which it blows. Thus at London, during six weeks of the winter of 1831, a north and north-east wind was accompanied by a *thaw*, and a south and south-west wind always by a frost. In Egypt, the south wind is also coldest, in winter. It should be noted that the great circuit-winds contain, without the limits of the trades, numberless smaller circuits and eddies of every variety of dimensions, which account for the various and opposite directions and apparent instability of the winds in the higher latitudes. In the United States these irregularities are chiefly confined to the surface winds.

Near the Canary islands, on the north-west coast of Africa, the trade wind blows from N. N. W. to N. E., the medium direction being N. by E.

In the most favorable region for the trades, in the Pacific, lat. 12° S., lon. 177° E., the prevailing winds, during near four months in the year, blow strong from W. N. W.

Many other facts deserve notice in this summary, but the writer does not feel himself at liberty to extend the subject.

Art. XVII.—*On the construction of De Luc's Columns, as modified by Zamboni: and on the modification of the single leaf Electrometer contrived by the author, by which the possible efficiency of a large electric series, may be ascertained, by testing a small portion of the members of which it is to be constituted. Also on the employment of the same instrument, as an Electrical Discriminator:* by Robert Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

Communicated by the Author.

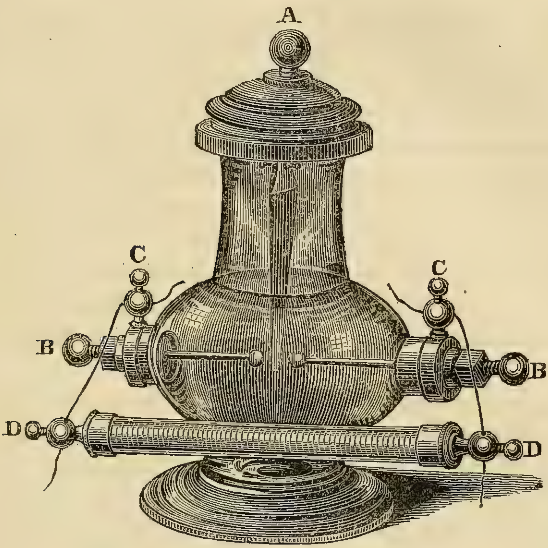
About fifteen years ago the construction of De Luc's electric columns as modified by Zamboni, was undertaken by Isaiah Lukens, one of our most skillful and ingenious mechanicians.

The materials employed were paper covered with leaf tin, (erroneously called silver paper,) peroxide of manganese, and crystallized sulphate of zinc.

The peroxide was finely pulverized, and mixed with a concentrated solution of the sulphate. The mixture thus formed was, by means of a brush, applied like a pigment to the surfaces of the paper not coated by the tin. The sheets were afterwards spread out on the floor of an apartment and left during the night to dry. By these means, unnecessary exposure to light was avoided, which Mr. Lukens, conceives to be injurious, especially as received directly from the sun. Next day the sheets were cut into disks of about five eighths inch diameter, by means of a hollow punch. The disks were then piled with the heterogenous surfaces alternating, as in other voltaic series, and were introduced into, and compressed within, glass tubes, accoutered as usual with pedestals, caps and bells. Notwithstanding his skill and experience, Mr. Lukens, latterly complained of occasional want of success, arising, as he supposed, from the defective quality of the manganese. In various instances, his columns, after being completed with the utmost care, proved inert.

The manipulation, likewise, according to his plan of operating, appeared to me, to be troublesome and precarious. He was accustomed to place a row of the disks, as large as could be conveniently handled, in a trough of sheet metal; and then transfer the pile thus formed to the glass tubes. This operation, to be successful, required dexterity.

Last winter, wishing to replenish the tubes of a pair of electric columns which had become effete, I contrived to avoid the risk of expending the labor and attention requisite to finish a series, while uncertain as to its eventual efficiency. I contrived likewise, by a very simple expedient, to facilitate the process of piling the disks.



The first mentioned desideratum was obtained by means of a single leaf of gold, suspended in a glass vessel, (represented by the subjoined figure,) between two knobs at the end severally of two brass rods B B, proceeding through opposite sides of the vessel towards each other, so as to be capable, if requisite, of meeting in the center. By means of screws, the knobs on these rods, were susceptible of being adjusted to any distance from the gold leaf, suspended between them. Externally the rods are so made and placed, as to be easily connected with wires. In the gold leaf thus situated, vibrations may be produced by a series of disks, comprising not more than one twentieth of the number necessary, to cause such a pendulum as commonly pertains to the electric column, to oscillate. In the case in point I found that the disks produced by one sheet of paper, were sufficient to make the leaf vibrate actively between the knobs. The mode in which this effect was produced, may be understood from the following figure; which represents the disks, as compressed, in due order, within a glass tube, by spirals of wire.

Each of the wires of which these spirals were formed, at the ends enclosed in the tube, being unaltered throughout the remaining portions of their length, were passed through corks closing the orifices of the tube. The series thus prepared, is to be placed in the situation of the electric column, appended to the instrument agreeably to Fig. 1, being in like manner suspended from the rods outside of the vessel by means of the projecting wires already mentioned. Thus situated, if there be any adequate degree of electromotive power in the series under trial, and the atmosphere sufficiently dry, the excitement of the poles will be communicated to the knobs, and be indicated by the consequent vibrations of the gold leaf, suspended between them.

When a larger series is used, such as that represented at DD, Fig. 1, the vibrations will be discontinued, only in consequence of the adherence of the leaf to one or the other of the knobs. This adherence usually ceases, on touching with a finger the little brass ball at the vertex of the instrument, to which the forceps holding the leaf is affixed. The finger being removed, vibratory pulsations will recommence, to be sooner or later arrested in the same manner as at first.

When duly connected with the poles of a voltaic battery, of seven hundred pairs, excited merely by pure water, the pulsations of the leaf are quick and incessant. It serves in this way to indicate the electric intensity, but does not furnish any criterion of the divellent, igniting, or electro-magnetic powers of a voltaic series.

It may readily be perceived, that the electrometer, constructed as herein described, constitutes an electrical indicator, which may enable us to discover the electromotive powers of various substances arranged as disks in a series, or as coatings to disks. I have already ascertained that aurum musivum spread on the naked surface, of the tinned paper produces an electromotive series.

The piling of the disks was facilitated by using a punch excavated so as to leave a point in the center, by which the center of each disk was punctured. By means of the puncture thus made, it was easy, even for an unskillful operator, to string them concentrically upon a silk thread, and to transfer them to the tubes without derangement.

The manganese which I employed with success, in the replenishment of the electric columns alluded to above, consisted mainly of needle shaped radiated crystals, aggregated into lumps. Mr. Lukens alleges that the crystallized manganese has always, agreeably to his experience, proved the best for the construction of electric columns.

The electrometer, with an electric column attached to it, as above represented, may serve to show the nature, as well as the extent of electric excitement; since, when an electrified mass is made to communicate with the brass ball A, from which the leaf is suspended, the latter ought to be attracted by that knob, which receives from the series an opposite excitement. Hence, the excitement of the electrified body being known, that of the poles may be detected; or the latter being known, the excitement of the body may be discovered.

This application of the electric series, is not, however, a new idea. I saw many years ago a notice of an electrometer, associated with an electric column, in such manner, as to be used as an electrical discriminator.

The great difficulty in resorting to this means of discrimination, is, that an electrified body may, by induction, produce in a conductor alternately, opposite states of electrical excitement. As it approximates the conductor, it may cause it to receive, or give out electricity; of course, when retracted, the conductor will have the opposite excitement to that consequent to approximation. Supposing the brass ball of the electrometer in question, to be affected in the mode just described, the leaf suspended from it, must be successively attracted by each pole. Besides, the excitement may be so strong, as to render that of the series nugatory; as in the case of a powerful magnet, which will attract either pole of a feeble one.

The direction of the first pulsation of the leaf, is the best criterion; but reliance should not be accorded to one experiment, especially when so easily repeated. I find that a gilt pith ball, if suspended in place of the leaf, will vibrate for a time. It is, however, like the leaf liable to have its movements arrested by an adherence, to one or other of the knobs.

Art. XVIII.—*Caricography; by* Prof. C. Dewey.

Appendix, continued from Vol. XIV. p. 354.

No. 127. Carex *decomposita*, Muh.
Muh. Gram. No. 58.
β. decomposita. Vol. X. p. 276.
Tab. S. fig. 58.

Spica decomposita vel paniculata ; spiculis androgynis supernè staminiferis alternis confertis permultis *distigmaticis;* fructibus ovatis triquetris brevi-rostratis vel acutiusculis parvis nigris glabris, squamam ovatam acuminatam albam subaequantibus.

Culm two or three feet high, large, triquetrous, striate, glabrous, tawny below, scabrous above, leafy ; leaves linear-lanceolate, long, often much surpassing the culm, distinctly nerved, rough on the edge with dark and striate sheaths towards the base ; spike decompound or paniculate, green ; spikelets very numerous and dense, lower ones with leafy bracts arranged closely along many branchlets, staminiferous above; stigmas two; fruit ovate, triquetrous, acute or short-beaked, bidentate, black and glabrous ; pistillate scale ovate, acuminate, white with a green keel, membranaceous, equalling or a little surpassing the fruit. Color of the plant light green.

Grows in Cherokee—Muh. Found abundantly by Dr. Folwell in a swamp near the river Raisin, in Michigan Territory, and sent to Dr. Gray of Utica, N. Y., who has obligingly sent me specimens.

This plant has commonly been considered a variety of C. *paniculata;* as such it was introduced into this Journal, Vol. X. p. 276. It is however so different from that species, that it well deserves the name given it by Muh. The discovery of this plant proves the correctness of that distinguished botanist in one more particular. On C. *paniculata*, L. the fruit is ovate-lanceolate, larger and longer, and the scale is longer and narrower in proportion, and tawny on the back.

No. 128, C. *panicea*, L.
Wahl. No. 96. Pers. No. 156.
Schk. Tab. Ll. fig. 100.

Spicis distinctis tristigmaticis; spica staminifera solitaria ; spicis pistilliferis subbinis subexsertè pedunculatis laxifloris remotiusculis, infima longo-pedunculata ; fructibus subglobosis obtusis ore integris, squama ovata acutiuscula paulo majoribus.

Tab. 8.

Fig. 58.

Fig. 59.

Fig. 60.

C. *foenea*, Muh.

C. *decomposita*, Muh.

C. *Grayana*, Dewey.

J.W.Barber, sc.

Culm about a foot high, triquetrous, leafy at the base; leaves shorter than the culm, linear-lanceolate, scabrous on the edge; bracts leafy, surpassing the culm, with short sheaths; staminate spike single, erect, an inch long, with ovate and tawny scales, white on the edge; stigmas three; pistillate spikes 1—3, oblong, loose-flowered, upper one or two with inclosed peduncles, the lowest often with a long peduncle projecting from the sheath, erect; fruit ovate, or subglobose, obtuse, subtriquetrous, glabrous, nerved, with an entire or subbifid orifice; pistillate scale ovate, subacute, tawny with a green keel, and white edge. Color of the plant a light green. This species should be placed in the section with C. *plantaginea.*

Found near Boston, by Dr. C. Pickering, and supposed to be introduced from Europe. This is a beautiful species, common in Europe, and finely *depicted* by Schkuhr.

No. 129, C. *Grayana*, Dewey.
Tab. S. fig. 59.

Spicis distinctis; spica staminifera solitaria oblonga; spicis fructiferis tristigmaticis subbinis oblongo-cylindraceis sublaxifloris exsertè pedunculatis; fructibus ovato-oblongis subinflatis subtriquetris obtusis vel acutiusculis ore integris, squama oblonga obtusa longioribus.

Culm 6—16 inches high, triquetrous, erect, striate, scabrous above; leaves linear-lanceolate, sheathing towards the base, scabrous and often longer than the culm; bracts linear-lanceolate, longer than the spikes; staminate spike single, erect, cylindrical, subtriquetrous, with scales oblong or obovate and oblong, tawny on the back and white on the edge; stigmas three; pistillate spikes two, sometimes one, oblong, near or subdistant, rather loose-flowered, exsertly pedunculate; fruit ovate-oblong, roundish-triquetrous, subventricose, smooth, glabrous, slightly tapering at either end, obtuse and entire at the orifice; pistillate scale ovate-oblong, rather obtuse, sometimes obovate and obtuse, shorter than the fruit, white on the edge, brown on the back with a green keel. Color of the plant a glaucous green. This species belongs in the section with C. *miliacea.*

Found in 1832 in a sphagnous swamp, near Utica, N. Y., by Dr. A. Gray, an active botanist, after whom it is named. It is said to have been found in Cedar swamp, N. J. It is a beautiful species, and has a remote resemblance to C. *livida*, Wahl., which grows two or three inches high in the marshes of Lapland.

The following species, described in Vol. X. p. 284, is now figured from specimens in the herbarium of Dr. Muhlenberg, and from another received from Georgia.

C. *foenea*, Muh.
Tab. S. fig. 60.

The description of this species already given, is accurate. In the Muh. herbarium are many specimens labelled under this name with a *question*. They agree with the description given in Muh. in general, and they are doubtless, as they differ from the related species, the plant intended by him. Although he says the spikelets are *subquaternate*, most of his specimens have *five*, many have *six*, and some *nine* spikelets; in this case several are closely aggregated at the summit. The capsules more resemble those of C. *straminea*, while the spikelets are more like those of C. *scoparia;* but they are wholly remote from the *chafflike* appearance of the former. Between these two, it seems to be an intermediate species.

Figures of the following species accompany this paper.

C. *decomposita*, Muh.: Am. Jour. Sci. Vol. X. p. 276.
" *Grayana*, Dewey.
" *foenea*, Muh.: Am. Jour. Sci. Vol. X. p. 284.

Among the writers on American Grasses, the late Dr. Muhlenberg of Lancaster, Penn. stands pre-eminent. His work, entitled *Descriptio Uberior Graminum, &c.*, published in 1817, is constantly referred to by succeeding writers on these genera. His Carices have been used as authority in the Caricography in this Journal. It is not surprising that many new species should have been discovered, since the plants of our country have been so fully examined by a multitude of botanists in the last fifteen years. As I have been permitted to examine his collection of Carices, in the possession of the Philosophical Society in Philadelphia, it will be interesting to those who study this difficult genus, to know the result of the examination and comparison of the present species with those in that herbarium. It will be seen that many species, not noticed in his *Descriptio*, are found among those there preserved. Some had probably been received after his work was written, and were to have been introduced on the revision of the manuscript, others he may not have satisfactorily determined. His work, honorable as it is to his name as a botanist, was a posthumous publication. I shall give his species in the order and under the number published in his *Descriptio*, and make such remarks as the examination renders proper, premising that the species are commonly in separate leaves in the herbarium, and of very easy reference. To J. Vaughan, Esq. I wish to offer my acknowledgments for his polite attention in giving me access to the herbarium, and also to Dr. C. Pickering for the aid afforded me in the examination. It is due to the memory of Dr. Muhlenberg to say, that some of the specimens may have been misplaced, even though undesigned, by some who have examined this collection of Carices.

Muhlenberg's Carices.	Remarks.
1. C. *sterilis*.	Exactly the same with ours.
2. — *cephalophora*.	Do.
3. — *bromoides*.	Do.
4. — *retroflexa*.	Do.
5. — *stipata*.	Do.
6. — *Muhlenbergii*.	Do.
7. — *multiflora*.	Do.
8. — *sparganioides*.	Do., but with it is a C. *Muhlenbergii*, and the new and distinct C. *setacea*.
9. — *rosea*.	Has a C. *curta* with it, while ours agree with both.
10. — *paniculata*.	Exactly like our plant.
11. — *scirpoides*.	Do., but has a C. *curta* with it.
12. — *lagopodioides*.	Do.
13. — *scoparia*.	Do.—Has the new C. *tenera* with it.
14. — *foenea*.	The plants under this name are labelled with a *query*, but are probably the plant he intended. If C. *foenea* has been found north of Pennsylvania, it has probably been confounded with C. *festucacea*. There is one of the new C. *cristata*, in the same leaf with this species, from the southern states.
15. — *straminea*.	Exactly our plant, but has the new C. *cristata* with it. C. *straminea* has its name from the *chaffy* appearance of the spikelets.
16. — *crinita*.	Embraces C. *crinita* and C. *paleacea*—ours the same.

Muhlenberg's Carices.	Remarks.
17. C. *Willdenovii.*	Exactly ours, but the calyx on some of the specimens is scarcely *leaf-like,* as on a specimen I have received from Kentucky.
18. — *polytrichoides.*	Exactly ours.
19. — *squarrosa.*	Do.
20. — *pedunculata.*	Do.—Has with it the new C. *nigromarginata.*
21. — *virescens.*	Do.
22. — *curta.*	Do.—Has a C. *straminea* with it.
23. — *hirsuta.*	Do.
24. — *Buxbaumii.*	Do.
25. — *varia.*	Do.—Has the new C. *floridana* with it.
26. — *dasycarpa.*	Do.
27. — *marginata.*	Do.—Has with it C. *caespitosa.*
28. — *vestita.*	Do.
29. — *polymorpha.*	One form of it seems to be the new C. *Halseyana.*
30. — *tentaculata.*	Precisely ours.
31. — *gigantea.*	Seems to be the same as the large species found in the Highlands.
32. — *lupulina.*	Ours exactly.
33. — *oligocarpa.*	Do., but only one specimen is quite like the figure in Schkuhr.
34. — *folliculata.*	Do.
Var. *xanthophysa.*	Do.
35. — *pubescens.*	Do.
36. — *plantaginea.*	This is the C. *anceps,* Schk., and the true C. *plantaginea,* Lam. is not in the herbarium, although it is common at the north.
37. — *fulva?*	Is thus written with a query in the *Descriptio;* it is not the C. *fulva* of Europe, and is the new C. *Elliottii.* It is finely described by Muhlenberg. A specimen of C. *pallescens* is with it.
38. — *granularis.*	Ours precisely, but has C. *flava* with it.
39. — *conoidea.*	Is not the C. *conoidea,* Schk., and is the new C. *blanda.* As Muhlenberg refers to the figure of C. *conoidea,* Schk. which

Muhlenberg's Carices.	Remarks.
	is so different from his plant, I think these specimens must have been misplaced.
40. C. *festucacea.*	Is now well ascertained, and the specimens agree with those of Muhlenberg, although the plant which has commonly been called by this name is altogether distinct. C. *festucacea* has *clubform* spikelets in maturity.
41. — *tetanica.*	The specimens so named are clearly the true C. *conoidea*, Schk., and the real C. *tetanica*, Schk. is not in the herbarium. Muhlenberg doubted whether his plant was the one intended by Schk. I have found it with the *blasted* capsules, so finely depicted on one of the figures by Schkuhr.
42. — *laxiflora.*	Ours precisely.
43. — *hystericina.*	Do.
44. — *pseudocyperus.*	Do.
45. — *flexuosa.*	Do.—Has the new C. *gracillima* with it.
46. — ———.	Without a name, but is the new C. *Torreyana.*
47. — *digitalis.*	Is not in the herbarium, but is supposed now to be well ascertained.
48. — *umbellata.*	Exactly ours, but the common variety, *vicina*, is not among them.
49. — *miliacea.*	Precisely ours.
50. — *trichocarpa.*	Do.
51. — *pellita.*	Do.—Has C. *filiformis* with it.
52. — *riparia.*	Do., but which we call C. *lacustris*, and Muhlenberg says it is thus named by Willdenow.
53. — *vesicaria.*	Do.
54. — *verrucosa.*	A strange mistake has been made on this plant, as it is C. *sempervirens*, Ell., but the name of Muhlenberg must be retained. The D. *verrucosa* in this Journal is wholly distinct.
55. — *recurva?*	Is the C. *Cherokeensis*, as it is certainly not the C. *recurva*, Schk. and others.

Muhlenberg's Carices.	Remarks.
56. C. *acuta.*	Exactly ours.
57. — *caespitosa.*	Do.—A specimen named C. *Oederi* by some correspondent, is C. *pallescens.*
58. Carex ? *lagopus.*	This is C. *Fraseri*, Sims, but is not considered certainly a Carex by Muhlenberg. It is not with his Carices, but among the grasses in another volume of the Herbarium, 1470. The leaves are radical, a foot long and an inch wide, and flat, like those of C. *plantaginea*, but without the appearance of a midrib, striate, with fine and stiff serratures. It was collected by Mr. Kinn of Philadelphia, in the Cherokee country. Pursh called it *Mapania sylvatica*, Aubl., but he is supposed to have been mistaken.

This comparison shows that several species are contained in the Herbarium, some of which were already described, which Dr. M. has not mentioned in his work on the Grasses.

Art. XIX.—*Observations on Combustion, and the powers concerned in that process;* by Samuel Morey.

TO PROFESSOR SILLIMAN.

Dear Sir.—It is now more than twenty years since I have been in the constant, I may say daily practice of making experiments on the decomposition of water, by mixing with its vapor that of spirits of Turpentine, and a great proportion of atmospheric air. In its decomposition by explosion, the object was to obtain, for mechanical purposes, a new and first moving power that should be perfectly safe, and altogether lighter and cheaper than that from steam. With a much less proportion of air, the object was to furnish a steady and pleasant flame like that from oil or gas ; in both of which objects I have succeeded.

In the course of these experiments, I could never fail to admire the wonderful, simple and convenient manner, which nature has provided for furnishing light and heat for the use of man. But for a long time, although one of the easiest things possible to produce flame and heat, yet how it was effected seemed a perfect mystery, the solution of which appeared altogether hopeless, as so many able and eminent chemists, with every possible advantage that had been or could be devised, had not succeeded;—still it was impossible for me to withdraw my mind from it.

When I began to reason as follows, I saw a gleam of hope that this mysterious process might be explained. It is well known that when the two electricities combine or unite, they always produce light and heat;—light and heat must therefore exist in them as a constituent part, or be combined with them in a latent or dormant state; it is quite immaterial which. For, as a given quantity of the electricities will decompose a given quantity of water, the result is always a given volume and weight of the gases known as oxygen and hydrogen.

It is also well known, that these gases by their own combustion always give out much heat and light, and reproduce the same quantity of water, that had been decomposed when the gases were evolved. It therefore appeared to me very evident, that in the decomposition of the water, light and heat had been imparted to the gases, solely by the electricities.

Again, if a given volume of those gases, while in an aërial state, will weigh say four grains, and if by their own combustion they produce four grains of water, it appeared to follow conclusively that the base of those gases was the elements of water combined with the electricities in a gaseous form; and if their weight was the same as that of the water produced by their combustion, it seems to prove that those gases have no other base whatever. Now, if a given volume of those gases, thus formed, will produce the same number of grains of water, can there be a doubt that the elements of combustion, and the base are the same in each?

Once more—take a given volume of oxygen and hydrogen gases weighing say twelve grains—inflame them; and if by their own combustion, much heat and light are given out and they produce twelve grains of water, can there be a doubt left, that water was the base of those gases and that they had no other?

That base must necessarily, as it does, greatly change the nature and operations of the electricities. Before, they had no sensible gravity; now they have acquired weight, and are subject to mechanical compression, expansion, &c. retaining all the properties of a permanent gas. When they are raised to the temperature of flame they then take fire; the heat and light, being left at liberty or disencumbered of their base now pass off into space with infinite velocity. But how they find their way back is not obvious; but probably it is by the way of the sun. About one-fifth of the whole atmosphere is composed of one of those gases, oxygen, but without its counterpart, hydrogen, we could have no flame in combustion. Where shall we find it? It is not in the atmosphere: It is too light or volatile to remain there. But in nature every thing is devised in infinite wisdom and for the comfort of man. A quantity of hydrogen equal, in all probability, to that of the oxygen of the air has been made to unite with, and is retained chiefly in the vegetables; in combination with other combustibles, it is readily disengaged by heat at a low temperature, and as the oxygen of the air is always present, when a flame is applied they instantly take fire and unite or combine, giving out their light and heat and thus forming flame, which continues so long as any vegetable matter remains to be decomposed and in part volatilized.

Combustion then is, in such cases, the result solely of the recomposition of water; here then is a source of light and heat that costs nothing, for if we can disengage the hydrogen of the water from the oxygen, it will as surely burn when it comes in contact with the oxygen of the air, at a proper temperature, as that disengaged from the carbon of the wood.

In the decomposition of water in combustion, the oxygen obviously unites with the carbon of the fuel with a disengagement of heat, leaving the carburetted hydrogen at liberty, which at a red heat is instantly inflamed on coming in contact with the oxygen of the air, forming water and producing intense heat as usual; water is again decomposed on meeting the first atom of carbon in combustion, and again recomposed with the same effect as at first; and this process must be continued and repeated while there is any carbon and unburnt air to meet in the combustion. This is made very evident in the great length of the flame with my improved lamp. It will be seen that all this additional flame and heat in the combustion arise solely from the oxygen of the atmosphere and costs nothing, so that the true and much the most economical principle in combustion is to furnish a due proportion of the vapor of water and a sufficient supply of air. Too much vapor dampens the flame, by excluding the air, and too much air renders it too explosive.

To me no operation in nature is more simple. On these gaseous electricities we live—they give life, warmth, and animation; one we inhale with every breath—the other we receive with our food. They combine or become united by animal heat, and that union supports animal temperature. In the decomposition of water have we not conclusive proof of the agency of the two electricities, one uniting with the oxygen and the other with the hydrogen in the exact proportion to form water again?

I have retained the name of oxygen and hydrogen gases, that I might be the more readily understood; but it appears to be very clear that the oxygen and hydrogen of the water take no part in the operation of those gases, or the effect they produce, any more than they did in their own decomposition or formation.*

The carbon of the wood appears to me to be formed by the hydrogen of the water and its electrical gas, combining or becoming solid in the course of its growth, while a part of the oxygen passes off to preserve the purity of the air, as it is well known that, by the solar influence, it is exhaled from living leaves.

This carbon of the wood is designed by nature, with evident wisdom and benevolence, to regulate the combustion of the hydrogen of the wood, performing a very similar part with that of the azote of the air, in the combustion and use of the oxygen of the atmosphere. Hydrogen gas is freely disengaged during the ignition of charcoal, while passing the vapor of water over it in an ignited state; but the flame is nearly smothered by the carbonic acid gas formed at the same time. For if the gases thus formed and disengaged are made to pass through a tube, containing a pint of cold water, the water takes up the carbonic acid gas and leaves the hydrogen at liberty, which naturally rises and is easily made to issue and burn in a constant flame.

The evidence I often observed in the effect of water in combustion made it very certain in my mind that it would be of immense benefit to the community if it could be effected in a way that would be regular, simple, and free from difficulties. It was this, together with an unconquerable inclination and determination to follow it

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* If we understand the author, oxygen is water united with one electricity and hydrogen is water united with the other, and when they unite by combustion, the water of both is precipitated, and the electricities are evolved in the form of heat and light.—Ed.

through life if I did not succeed short of it, which made me persevere for so great a length of time. This resolution was perhaps imprudent; it certainly would have been so had I not supposed I had the means within my own reach. I have no doubt that I have tried lamps, stoves, and machines in more than four thousand different forms for effecting these purposes, and yet not many months have elapsed since I have felt entirely satisfied.

The experiments which I have made, have proved practically, that an engine with a power equal to driving a boat four miles per hour, and a rail road car twice that distance in the same time, with ten or twelve passengers, may be made for one hundred dollars: and that the engine with its preparing vessel, (a substitute for the boiler in the steam engine) need not weigh one hundred pounds,—and the expense of working it will not exceed ten or twelve cents per hour. There are certainly no difficulties to be removed. These facts have been verified practically and repeatedly before hundreds of people.

Some recent improvements in the mode of constructing lamps for burning water to produce light and heat have perfected the operation for these purposes. It now carries demonstration in every form. For instance, when you put but one-fourth of a gill of spirits of turpentine into the lamp and as much water, and raise the temperature to less than that of boiling water, the vapor that comes over will be in the ratio of about equal parts of each; if, in the combustion of those vapors, a due proportion of air is mixed and inflamed, it will in a few minutes boil a two quart copper tea kettle. If small brass wire is brought over and in contact with the flame, it instantly drops in pieces—small copper wire is readily melted—fine iron wire, if the proportions be right, is instantly inflamed—and thin sheet copper with a small piece of silver or silver solder on it with borax, being exposed to the flame, the silver melts in a few seconds, and the copper very soon: and this is done while the vapor is not concentrated in any way, and issues only with a velocity about the same as that of gas in gas lights.

This discovery gives every promise of supplying a much cheaper fuel, (as a fuel,) exclusive of a clear saving of light, than any one now in use. It is my intention to introduce my lamps, &c. into use as soon as I conveniently can; this must be postponed until I can again leave home, which I trust will be early in the ensuing autumn.

Oxford, April 14, 1833.

Remark.—We have seen some of Mr. Morey's experiments, and can testify to the correctness of his statements, as regards the great amount of heat and light evolved by combustion of the vapor of water mixed with that of spirits of turpentine or alcohol, and duly modified by common air. The results are very striking and beautiful, and we can see no reason why they should not prove of great practical utility.—Ed.

Art. XX.—*Life of Linnæus; by* A. L. A. Fee:—*in* 1 *vol.* 8*vo., forming the first part of the Memoirs of the Royal Society of Sciences, Agriculture and Arts of Lille for* 1832.

(Translated for this Journal from the Bib. Univ., by J. H. Griscom, M. D.)

Much has been written upon Linnæus; and the eminent rank which he held, and the prodigious influence which he exerted over natural history, render what has been written sufficiently intelligible. But of the biographical works which we possess in French upon this man of genius, some are either too devoid of details, to give much account of his history, or written too soon after his death to enable their authors to appreciate his influence with impartiality. Men are, in truth, like edifices; in looking at them when close at hand, we can form a just estimate only of those which are made up of details and do not rise to a very great height; but with regard to temples and elevated obelisks, we can judge of them only at a distance. With respect to men who have been predominant in their age, and have impressed upon it a new direction, we can judge of them properly only after their works have borne their fruits, and prejudices have become extinct. Mr. Fee has therefore rendered a real service to the history of science, in collecting and arranging carefully all the most authentic statements which could be found, either in works published in Sweden or Germany, or in the manuscripts which he was able to procure, relative to the life of the Reformer of natural history.

His work is composed, 1st, of the translation of the life of Linnæus, written by himself, and published by his disciple Afzelius; 2d, of extracts from his correspondence with naturalists of his time; 3d, of a collection of anecdotes relating to Linnæus and his labors; 4th, of a bibliographical notice of his works.

Linnæus has on many occasions related the story of his own life, and the narrative which forms the first part of Mr. Fee's work is the most complete of these different auto-biographies. Even in the translation, the peculiar style of Linnæus may be recognized; it is a rapid recital, precise, full of fact, with occasional flashes from the fire of a poetic imagination.

Charles Linnæus was born at Râshult, in May,* 1707; his father was a country clergyman, of a mild character and an even temper. His mother had, he said, much mind, a sound judgment, and great vivacity of manners, furnishing an additional example in favor of those who maintain that all celebrated men have had intellectual mothers, and who thence infer the influence of the earliest years over the intellectual development of children. Young Charles, from observing the flowers in his father's little garden, had received a taste for botany, and his mother, notwithstanding her intelligence, was so vexed at the direction which this gave to his studies, that she expressly forbade her other son Samuel from entering the garden. The success of Charles in the studies of the college, was far from answering to those early indications of talent. He, never in his life, had much facility in the study of languages, which is too often made exclusively the criterion of success in colleges, and he went to the University of Lund with the reputation of a very indifferent scholar. He there decided upon the study of medicine, and experienced great difficulties on account of his poverty. The naturalist Stobæus received him into his house, which gave him an opportunity to see a small museum, and this confirmed his taste for natural history. He went afterwards to Upsal, where Olaus Celsius having heard of his talents and his indigence, received him into his house, in order to aid him in his work upon biblical botany, and placed at his disposal a rich library. He derived some assistance also from giving lessons to the students, and he even aspired to the place of Rosen, the adjunct professor. He took Tournefort as his guide, in the study of plants, (whom he knew principally from the abstract published by Johrenius, under the title of *Hodegus botanicus*,) and subsequently the treatise of Vaillant upon the sexes of plants opened his eyes to a new light. Rudbeck encouraged him to pursue it, and it was at this epoch, at the age of twenty two years, that he began to write the *Bibliotheca botanica*, the *Classes plantarum*, and even the *Genera plantarum*.

Encouraged by the advice of Rudbeck, he then undertook a journey to Lapland, a painful journey, on account of the climate and the rough nature of that country, as well as from the smallness of his means, which obliged him to travel alone, and destitute of many of the necessaries of life. He remitted the account of this

* Some say the 3d, others the 22th of this month.

tour to the Royal Society of Sciences at Upsal, obtaining with difficulty a very slight assistance from that body; he found some resources in giving private instruction in mineralogy and botany, and when in 1734, he set out to visit Dalecarlia, he was accompanied by several of his pupils. One of these, Browall, afterwards bishop of Abo, advised him to look out for a wife of sufficient property to furnish him with means; he accordingly solicited in marriage the daughter of Doctor Moræus, who was deemed wealthy, and to his great surprise, as he said, his suit was accepted. It was settled, that the marriage should take place within three years, and that the interval should be spent in travelling.

He betook himself to Holland, where he received a doctor's degree, and became intimate with the most celebrated naturalists of the time, Gronovius, Van Royen, Burman and Boerhaave; he astonished them by his knowledge, and his readiness in naming the plants which they presented to him. Cliffort, who had the most beautiful garden in Holland, engaged him to remain with him in order to aid him in its direction, and it was in this magnificent establishment that he enlarged his ideas upon vegetation. He there published many important works, (*Hortus Cliffortianus, &c.*) Aided by his protector's generosity, he went into Germany, where he became acquainted with Dillenius; and upon his return to Holland, at the close of 1736, his reputation was already so great that the Academy of Naturalists, in receiving him into its bosom, gave him the title of Dioscorides the second. His method was already adopted by the Dutch botanists and publicly taught at Leyden. He then made a tour to Paris, where he became well acquainted with Antoiné and Bernard de Jussieu, and where, it appears, some efforts were made to retain him; but he preferred to return to Sweden, and the extreme difficulty with which he spoke foreign languages appeared to have had some influence in this resolution.

Upon his arrival, he was treated as a stranger, and he who was considered by one part of Europe as the prince of botanists, was unable at first to find either a place in the university or patronage as a physician. He obtained, however, almost by chance, a small place at the School of Mines, and was afterwards appointed physician to the Admiralty; his practice increased so as to yield him nine thousand crowns a year. He married, and was appointed professor in conjunction with Valerius, and henceforth was placed in a position worthy of his talents; he devoted himself with renewed zeal to natural history. His *Systema Naturæ*, the editions of which have been so much multiplied, fixed upon him the eyes of Europe. Academies disputed for the honor of his name; his pupils travelled over the world, and transmitted its productions to him. Favors from his sovereign succeeded; he was raised to the rank of noble, on account, it is said, of having discovered the generation of pearls, *Mya margaritifera;** pensions were granted him, as well as domains to him and his posterity; and he who in his youth had been obliged to mend his own shoes, found himself, from the lustre of his labors, placed in old age in a state of great ease and social elevation.

The latter years of his life were passed in supplying new editions of his works, in publishing, under the form of academic theses, several piquant dissertations, which have been collected together under the title of *Amœnitates,* in giving private lessons (often during eight hours a day) to select pupils, in looking after the interests of the Academy and the public collections, and in arranging his own herbal. In 1773, he was attacked with a severe quinsy; in 1774, while giving a lesson in the botanic garden, he was struck with paralysis, to which succeeded a tertian ague. He ceased in 1776 to write his own life; his intellectual faculties declined,—a state the more painful from his being sensible of it himself. His writing became illegible, and he sometimes mixed Greek and Latin letters in the same word. Finally, he forgot even his own name. In this condition, the only thing which appeared to reanimate him was the sight of his united collections at his country house at Hammarby. He expired on the 10th of January, 1778, aged seventy years and seven months.

The second part of Mr. Fee's work contains extracts from the correspondence of Linnæus with the naturalists of his time. This correspondence was immense, and Linnæus said himself to the Abbe Duvernoy, that ten hands like his own would not suffice to answer all the letters which were addressed to him. More than a thousand of his letters, addressed to one hundred and sixty correspondents, have been preserved, almost all were written in Latin; that of the earliest known date is addressed to Rudbeck, his benefactor, dated 29th of

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* It was there that he received the name of *Von Linné* instead of that of *Linnæus*, which he had always borne, not for the purpose of Latinizing his name, as has been believed, but because it was the true name of his family. The name of Linnée, which has often been given him in French is erroneous, and belongs only to the plant which is dedicated to him.

July, 1731, and his last to Masson, an English botanical collector, in 1776. They consequently comprehend a space of forty-five years. It must be observed, that notwithstanding the mental decay of his latter years, Linnæus was one of those whose literary lives are the longest. His first work *(Hortus Uplandicus,*)* was dated in 1731, and the last *(Planta Aphyteia,)* in 1776, forming a duration of forty-five years, during which the publications of this indefatigable man, rapidly succeeded each other. Mr. Fee has given a very careful chronological list of them. Almost at the same time, a learned Swedish botanist, Mr. Wikström, published in his *Conspectus literaturæ botanicæ in Suecia*, (1 vol. in 8vo. *Holmiæ*, 1831,) a list and a review of the botanical writings of Linnæus.

The part of Mr. Fee's work relating to the correspondence of Linnæus, being only an extract, need not detain us, but the third part claims more attention, from its containing some curious anecdotes of this eminent man.

The relation of Linnæus with Artedi, is that in which he shows himself in the most endearing light. On arriving at Upsal, in 1728, Linnæus inquired for the student who evinced the most talent; Artedi was named. The great naturalist soon entered into close intimacy with him; they labored together at different branches of natural history, and after a time of trial, each ceded to the other the parts in which he appeared superior; thus Linnæus yielded to Artedi, chemistry and ichthyology, and Artedi gave up to Linnæus, plants, birds and insects; the two friends continued to work together upon stones and quadrupeds, where they were judged equal in strength. This intimacy was interrupted by their travels; they met again in Holland in 1735. Linnæus presented Artedi to Seba, in order to aid him in publishing his great work. Their meeting had re-established the habits of their youth of confiding to each other their labors, and of mutual consultation. Artedi, unhappily fell into one of the canals of Amsterdam and was drowned. Linnæus engaged Mr. Cliffort to buy his papers, and published, under his friend's name, the valuable works which he had left upon the classification of fishes.

The relations between Linnæus and Dillenius commenced in a less benevolent manner. This botanist, who, at the time of Linnæus's

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* This work is very rare, and is not cited, either in the *Bibliotheque de Haller*, nor in the very recent and very accurate list of Wikström; I point it out here agreeably to Mr. Fee.

first appearance, was without any doubt, the most able of his time, distinguished himself by great exactness in the study of details, but never appeared to be seriously engaged with general ideas; he had, of course, but a very inadequate perception of the real value of the innovations of Linnæus, but felt strongly the embarrassments which a new language, momentarily, introduces into science.

This man is confounding all botany, said Dillenius to his friend Sherard, on seeing Linnæus enter. In many respects, however, he yielded his prejudices. Linnæus, in his sojourn in England, and in his correspondence, astonished him by the extent of his knowledge, and brought him over by his urbanity.

Another rival of Linnæus, who would have been the most dangerous of all, had he proceeded directly in the same career, was Haller. This astonishing man, at once a poet, physician, anatomist, physiologist, bibliophile, and naturalist, had very remarkable ideas relative to the natural method, and would doubtless have made immense strides, if botany had been the special object of his researches. He confined his ideas to a too contracted sphere, the Flora of Switzerland, and he rendered his work less popular, by not distinguishing the nomenclature of Linnæus from his classification; and in rejecting the first, which is excellent, from an antipathy to the second. These two celebrated men were, for a long time, on a footing of intimacy and confidence, and notwithstanding a diversity of opinions, they rendered each other justice. Some light clouds appeared, from time to time, on occasion of their reciprocal criticisms, and there arose a sort of misunderstanding between them, by reason of Haller's indiscretion, in publishing some old letters of Linnæus, which contained private details of his life, and especially relative to his marriage.

It is but justice to Linnæus, to state that during his whole life he refrained from replying to the criticisms, (often very severe,) that were made upon him and his writings, either because he disdained them, or because he felt that he had a larger and more glorious mission to fulfil.—He allowed Siegesbeck, Browall, etc. to let loose their choler against him, and enjoyed, in peace, the admiration of his age. The only instance of transient ill will, which can be cited, is against Browall. This person, in his youth, was very humble, in relation to Linnæus, and the latter dedicated to him a genus which contained only one species, *Browallia demissa*. Afterwards, made Bishop of Abo, Browall assumed to be a great lord, and Linnæus found a second species which he named *Browallia exaltata*. Browall having become furious, wrote against Linnæns, pamphlets in no very measured terms ; a third species was found, a little different from the genus, and Linnæus named it *Browallia alienata.* By a singular chance, no other species of the genus, has ever been found, so that the names of Browallia still preserve the anecdote entire.

Mr. Fee takes the trouble to exculpate Linnæus from an accusation against him relative to Buffon ; the genus which bears the name of this great naturalist is written in Linnæus (with a single *f*) *Bufonia*, which, it is said, was designed to indicate toad plants. Ventinat, wishing to exculpate Linnæus, says that he has given this name, because the plant grows in moist places, while on the contrary it grows upon the most sterile rocks. The truth is it was not Linnæus who committed this orthographical error. The genus was named *Bufonia* by Sauvages, in his method of leaves, and with a dedication so honorable to Buffon, that it is evidently only a simple error. Linnæus admitted it without any further examination, and was indignant that so injurious an idea should be attributed to him.

The error of the public rested on the fact that many of the names established by Linnæus had allusions to the persons to whom the genera were dedicated ; it is thus that he named *Bauhinia*, in honor of the two illustrious brothers Bauhin, a genus, whose species have all the leaves composed of two folioles ; again, having received a genus from India, collected by surgeon Dalberg, sent by the latter to his brother, a banker at Copenhagen, and transmitted by the banker to Linnæus, he named the genus *Dalbergia ;* one of the species had the fruit pointed, this was the D. *lanceolaris*, in honor of the surgeon ; the fruit of the other was round, this was the D. *monetaria* in honor of the banker.

The collections of Linnæus were very considerable for his time, and his herbal was, in particular, the special object of his care and affection. He states in autographical notes, the origin of the plants which compose it, many of which were brought from the most distant countries, at a time when travelling was far from being as easy and as frequent as at present, and when travellers, too much penetrated with the idea that the same vegetables might be found in very different countries, neglected often to collect them. "*My herbal*," said Linnæus, "*is without contradiction the greatest that ever was seen ;*" but although this assertion may not be very just, (since the herbals of Vaillant and Tournefort, then in existence, appeared more considerable,) if admitted to be such, this herbal must have contained about 8000 species, for the works of Linnæus contain, altogether an indication of 7982 plants, and if some should have been obtained after their publication, it is certain that others pointed out in his books, are wanting in his herbal. We may judge of the progress which botany has made within half a century, and in a great measure by the influence of Linnæus, if we take into consideration the increase of actual collections. There exist many herbals of thirty and forty thousand species, and one of them reaches at present to about fifty-five thousand. Its proprietor has sometimes in one single year received more species, than Linnæus during his whole life. The globe is explored in all parts, with an activity which astonishes the imagination, and it may be supposed with some truth, that within half a century, there have been discovered annually a thousand species.

Though the herbal of Linnæus has ceased to be one of the greatest in the world, it is not the less valuable, either because of the sentiment of admiration which is attached to its founder, or because it is the base and type of all the nomenclature. After the death of Linnæus this herbal passed into the hands of his son; but the latter surviving him only two years, his mother, who, it is said, was fond of money, endeavored to reap something from it. Fearing that the Government would not wish to retain it, or would give only a low price for it, she offered it to Sir Joseph Banks. Mr. Fee says that the latter not being in a situation to make the purchase, spoke of it to Mr. Smith. The anecdote, as I have received it from the mouth of Smith, is honorable to both and deserves to be recorded. Mr. J. Ed. Smith, then very young, and a passionate admirer of Linnæus, at a public dinner, stated in a very animated manner, the price which was asked for the herbal of Linnæus, and his regret that his fortune did not permit him to dispose of a thousand pounds sterling which was asked for the herbal, the library, and the manuscripts of the great naturalist. Banks hearing of this enthusiasm, sent for Smith, encouraged him to proceed and offered to lend him the money requisite to this acquisition. Thanks to this generous instigation, the bargain was made, and by the care of the English Consul, the herbal was sent to England. It has been said that the Swedish government, indignant at its being carried off, sent a frigate in pursuit of the vessel which was bearing off the herbal of their countryman, and this fact has been cited as an illustrious homage rendered to his memory. I have before me, a portrait of Smith which has a vignette in which is seen the Swedish frigate pursuing the vessel carrying the precious herbal. I am sorry to excite doubt upon a story so interesting and honorable to science, but I am, in conscience, obliged to add that Mr. J. E. Smith told me that there was not the least truth in it.

I may add that this learned man has used these collections, in a manner the most worthy of their origin. He has published several works in which by having the original samples, he has removed difficulties to which the laconicisms of Linnæus had given rise; he has often had the complacency to resolve the doubts which naturalists have had respecting the sense of the writings of Linnæus; finally he has permitted those who had difficulties on particular points, to consult the herbal, and has granted this permission with all the grace and goodness which enhance the price of it. I cannot recall without emotion the hours I have passed with him, occupied in running over this precious depot, and I cannot speak of it without rendering homage to his memory.

At the death of Smith, the Linnæan Society of London of which he was the President, and which was founded about the time that this herbal was brought to England, acquired the collections of Linnæus enlarged with all those of Smith; these herbals deposited in a place consecrated to the sciences, are thus preserved for the future exploration of botanists.

After thus furnishing, both from the work of Mr. Fee, and from our own recollections, the facts which appear to us the most valuable in the life of Linnæus, this would appear to be the place to endeavor to appreciate the services which he has rendered to science; but this undertaking would be immense, and would deserve to be treated of in a special work. We shall limit ourselves to the remark that the eminent and incontestible service which he has rendered to natural history, has been to create a language for it, in relation both to terms and to names.

Before his time, the terms had no precise meaning, and every body in describing animals and especially vegetables, employed either vague terms or periphrases, which rendered their writings long, obscure, and difficult of comparison with each other. Linnæus gave precision to the terms, and created, especially in botany, many which were clear and elegant; he employed this new language with remarkable address and ability, and thus changed the face of all works of description. Doubtless, in proportion as natural beings have become better known in their details, it has become necessary to modify the sense of some terms and to add others; but it has been done according to the principles laid down by Linnæus, in so much that it is not without justice that even at the present day, we are disposed to attribute to him, all the happy additions which have been made to that Linnæan language, which has rendered natural history so clear, concise and popular.

The nomenclature of animals and plants was in a still greater state of disorder, anarchy and embarrassment, than the style of description. Each name was composed of a long phrase, so that the simple catalogue of a garden formed a volume in quarto, and no one knowing these names by heart, they were repeated without precision. Linnæus fancied he might apply to the nomenclature of natural beings the same system which is universally admitted for that of the individuals of the human species; that every animal, every plant, might have a generic name, which would correspond with our family name, and a specific name, which would represent our baptismal name; thus the names became short, clear, precise; they could easily be remembered, and their stability might lead us to hope, that they would one day be universally employed.

These two grand bases, the language and nomenclature, being determined, Linnæus had the courage to apply them himself to all natural history; he traced the picture of the three kingdoms according to these principles, and astonished the world, both with the variety and precision of his knowledge, and by the care which he took to introduce into this vast picture a crowd of new objects,—of pointed observations; he cited under each article those ancient names which were the best established, the figures the least imperfect, the localities the most certain, which he could obtain. He authenticated his works by a multitude of ingenious and original memoirs, in which he developed the points which were the least conformable to the conciseness of his habitual method, &c. Was it surprising that such immense labors should astonish the learned world, or such an entire change of forms and terms should embarrass those who had spent their lives in learning others, and that naturalists should thus become divided, on the one hand into admiring enthusiasts, and on the other into detractors, unjust to the merits of Linnæus?

If from the form we proceed to the classification, we shall find, in analyzing it, a curious example of this double position; that some have greatly admired what Linnæus himself regarded as precarious and conditional, and others have censured those parts of the works of Linnæus, in which he is the most worthy of eulogy. I will explain myself; Linnæus appeared to me to be the first who clearly comprehended the difference between the natural and artificial methods; and, notwithstanding the vivacity of his disposition and his desire to regulate the whole of natural science, he did, I say, very clearly understand that the number of objects known in his time, and the manner in which they were described, were insufficient to lead to a true and regular natural method; he therefore resorted, in practice, to a system purely artificial, and to fragments of natural order for study and meditation. He has, very formally, and with frequent repetitions, said that the artificial system was provisional, good for finding names, and nothing more, but that the natural method was the true end of science and the most worthy of giving a direction to the labors of naturalists; hence he gave private lessons to his favorite pupils, and allowed no occasion to pass of inducing them to appreciate their importance. But the learned world has committed, in this matter, two curious and contradictory errors; some, like Buffon, constantly reproach him, for having in his sexual system brought together objects of different natures, as if this bringing together was not inherent in every artificial method, which can only be compared to a simple dictionary,—and as if Linnæus had not corrected these chance arrangements in his fragments of natural order; others, and those too who are exclusively called Linnæans, have considered the artificial system as the whole of science; they have adopted as a permanent order what their master had furnished only as provisional; they have abandoned with disdain the researches of that natural order which Linnæus had declared to be the true end of science; thus contracting this great man to their narrow conceptions. They thus act in contradiction to the principles which he professed, and in attaching themselves to the exterior form of his writings, they have lost sight of the depth of them. Linnæus is much greater than the pretended Linnæans would make us believe, and I have no doubt, if he could appear among us again, he would be their greatest adversary. But, truth will make its way every where; artificial methods are reduced to their true value and proper rank, the art of finding names, and each one feels, at present, that a natural method, well understood, is the genuine expression of true science. D. C.

Art. XXI.—*Geological Observations upon Alabama, Georgia and Florida; by* Charles U. Shepard.

In ascending the Alabama River, during the month of January last, occasional opportunities were presented me for observing the geological features of the country bordering on that river; although they were limited to such stoppages as were made by the boat in wooding, or in discharging freight. Since my return to the north, I find I have been preceded, in part, in the nature of my researches;* but, as I am able to indicate certain localities, and to particularize a few fossils, the notices I had anticipated may not appear wholly superfluous.

The result of my observations upon the formations of this district lead me, for the present, to regard them as of earlier date than those of the Ferruginous Sand Formation of New Jersey and Maryland, and as belonging to the Plastic Clay of the Tertiary; a more extended series of observations, however, may establish the opinion respecting them entertained by Dr. Morton.

My first observations were made at Prairie Bluff, a place fifty miles above Claiborne, upon the west side of the river. The river passes directly under the side of the bluff, which is sixty or seventy feet high and six or eight hundred feet long, exposing a perpendicular section of a white, slightly cohering sandstone, which is imperfectly stratified, and in many places fast crumbling down into sand. The grains composing this rock are scarcely larger than a pin's head; and are white and transparent. The principal cement, or cause of its integrity, appeared to be the shells it embraced, and an occasional admixture of white clay. Amongst the ruins of this rock, I gathered very distinct specimens of Exogyra costata, a large species of Gryphea, (mutabilis?), Ostrea falcata, (intermediate between the common New Jersey variety and the variety *nasuta*, figured by Dr. Morton, the shell extremely thin and fragile,) a species of Cyrena, casts of a Natica, a very thin shelled Terebratula? Turbinolia and Vermicularia.

Five miles above, at Campbell's Landing, which is upon the same side of the river, I visited another bluff of smaller extent, in which

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* Vid. this Journal, Vol. XXII, p. 94, and Vol. XXIII, p. 228.

the rock was of the same description, excepting, that it was firmer. The only fossil it appeared to contain, was the Exogyra costata.

In ascending still higher, I observed high clay banks, regularly stratified, and sometimes alternating with sand and pebble beds. At one of these, upon the east side of the river, where the steamboat stopped for wood, I collected several samples containing shells; among which is a small Ostrea, about the size of the O-crista galli, a Mytilioides, a Gryphea, and a Terebratula?. The clay is fine grained, of a bluish grey color; and contains minute scales of white mica.

In approaching Montgomery, a continuous bluff of more than a mile in extent, and upon which the town is situate, comes into view. Its height, where the river passes under it, is from sixty to eighty feet; and its almost perpendicular face of red gravel and sandstone, presents a very striking contrast with the green forest by which its summit is crowned, and with the dark current flowing by its base. This bluff is almost entirely made up of ferruginous sand, arranged in layers distinguishable by the shade of red or yellow which they present, and occasionally agglutinated by hydrous oxide of iron, so as to form a tolerably firm sandstone. The materials of this formation are almost exclusively quartzy, consisting of small grains, rarely larger than a pea, and invariably deeply stained by oxide of iron. In a few places, alternations of what I consider the Plastic Clay, were noticeable. The sand and sandstone did not contain, so far as I could discover, any fossil remains, whatever.

In crossing the Chattahoochee River, at Columbus, where the banks are high, I noticed the same red gravel, sand and clay, as on the Alabama. In passing the ferry, the newly constructed piers of a bridge to be thrown over the river, were seen to be built with gneiss; and this rock was soon abundantly discovered in place, on my road to Milledgeville. Indeed, large blocks of quartz rock and pieces of granite were seen all along upon the road. In crossing Flint River, gneiss was seen in place. At Clinton, I remarked boulders of greenstone.

In approaching Augusta from the south west, across the sandy plains, when within four and a half miles of the city, I passed what is called a limestone quarry. Being in a public conveyance, it was out of my power to examine the locality, otherwise than from samples of it afterwards seen at Augusta. It presents the strongest analogy, on the whole, to the Upper Fresh Water Limestone. The rock is a calcareous sandstone, which, as described to me by the chief quarry-man, is arranged in nearly horizontal strata. Between the different layers, there is considerable difference as respects the coarseness of the ingredients; so that in working it, they are obliged to reject a large portion of the rock,—the variety employed being composed of grains rarely larger than half a pea. The layers of this description he described to me as being thin. It is used in Augusta for door steps, window caps, &c. and is worked with great ease.* Its color is white, and its appearance is not unlike to that of a fine grained granite, the feldspar of which has become converted into a kaolin. The grains of the quartz are quite angular, the mica is white and in large proportion, while the calcaraeous cement resembles chalk or white clay. Intermingled with it, we observe occasionally little fragments of black Tourmaline. It passes into a compact variety, of a porcelainous appearance, of the precise hardness, color and fracture of the Munich lithographic stone; and I cannot doubt but that the quarry will afford pieces admirably adapted to this valuable purpose. I searched without success for fossil remains in this rock.

When at St. Mary's, in Georgia, I was presented with a small collection of bones, fossils and pebbles, from the famous Suannee spring in Florida; and which had been brought up from the bottom by diving. They principally consisted of fragments of the teeth and bones of the Sea Cow, (*Manatus americanus*,) among which are portions of the rib, whose greatest diameter is one and a half inches, and fragments of teeth above an inch long. These remains, as well as the other articles of the collection are coated with a blackish brown covering of a bronze-like appearance, from the precipitation of sulphuret of iron.

But the most interesting portion of this collection consisted of the teeth of the shark, spines of the Echinus, and the palates of fishes, one of which is of a form to me entirely new, and another closely resembling, if not identical with, Fig. 5, of *Palais de differentes espèces de poissons inconnus*, in the *Dictionnaire des Sciences Naturelles*. In addition to them, I recognised obscurely defined fragments of claws belonging to some crustaceous animal, probably to a species of Cancer, and agglutinated fragments of Ostrea shells. The palates, and these last, were completely silicified.

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* The quarry is the property of Mr. Henry Cummings. The stone when dressed sells for 50 or 75 cts. the superficial foot. The sales for the last year were $3100.

These specimens are the more interesting as they seem to approximate the formation from whenec they come, to the celebrated Maëstricht beds of the Alps; while they at the same time evince its relation to the cretaceous group now known, through the labors of Dr. Morton and others as one of our most extensive geological deposits.

The same collection contained pieces of Hyalite, or silicious sinter, whose appearance led me to conjecture that they were of comparatively recent origin, and even to imagine that the process of silicification may not yet be wholly suspended in these waters: the thermal character of the water discharged from this spring, as well as from numerous others in the vicinity would favor the supposition: and I confess when I reflect upon the specimens before me, and upon these immense gushing fountains, distributed every where over the Floridas, which never intermit in their discharge of water, and which apparently comes from great depths below the surface, I cannot avoid indulging the theory that the silicifying process of strata here and there in numerous places from North Carolina to the Gulf of Mexico, was the result of thermal fountains, whose activity has long since ceased, and whose only remaining vestiges in the country are the springs, like those of Suannee, above alluded to.

A five days' journey through an almost uninhabited country during the most unpropitious season of the year, alone prevented me from visiting the Suannee spring, which is justly regarded as a great curiosity in that country; besides, being a place of considerable resort in the summer, on account of its medicinal qualities. I was able to obtain some information respecting it, from gentlemen at St. Mary's; and in particular from Rev. Mr. Pratt, who had visited it during the previous year.

But before describing the spring, it may be interesting to give some sketch of the Suannee, or Little St. John river, into which the fountain in question discharges. The great characteristic of this stream is its limpidity, on which account it is sometimes called the *pellucid* river. It begins its course in the great swamp Oaquaphenogaw or Okefonoco, near the source of the Great Satilla river, and pursues a southerly direction, at last emptying itself, after a course of two hundred miles, into the south-western point of Apalachie bay. Its breadth through the greater part of the course varies between eighty and two hundred yards, and its depth from ten to twenty feet. It is no where fed by brooks or streams; but appears to derive its waters wholly from fountains breaking up from its bed and banks. By travellers, it has often been compared to a great canal, which occasionally presents elevated banks, but generally cuts through level pine woods, having clean, gravelly banks, and thus presenting a marked contrast with southern rivers, whose sunken borders, so frequently offer a mere jungle of cane-brake, tall grasses, shrubs and trees. In Bartram's travels in North America* we find the following account of this stream, and his explanation of the unusual transparency of its water.

"The Indians and traders say that this river has no branches or collateral brooks or rivers tributary to it; but that it is fed or augmented by great springs which break out through the banks. From the accounts given by them, and my own observations on the country round about, it seems a probable assertion; for there was not a creek or rivulet to be seen, running on the surface of the ground, from the great Alachua Savanna to this river, a distance of above seventy miles; yet, perhaps, no part of the earth affords a greater plenty of pure, salubrious waters. The unparalled transparency of these waters furnishes an argument for such a conjecture, that amounts at least to a probability, were it not confirmed by ocular demonstration; for in all the flat countries of Carolina and Florida, except this isthmus, the waters of the rivers are, in some degree, turgid, and have a dark hue, owing to the annual firing of the forests and plains; and afterwards the heavy rains washing the light surface of the burnt earth into rivulets, which rivulets running rapidly over the surface of the earth, flow into the rivers, and tinge the waters the color of lye or beer, almost down to the tide near the sea coast. But here behold how different the appearance, and how manifest the cause! for although the surface of the ground produces the same vegetable substances, the soil the same, and suffers in like manner a general conflagration, and the rains, in impetuous showers, as liberally descend upon the parched surface of the ground; yet the earth being so hollow and porous, these superabundant waters cannot constitute a rivulet or brook, to continue any distance on its surface, before they are arrested in their course and swallowed up: thence descending, they are filtered through the sands and other strata of earth, to the horizontal beds of porous rocks, which, being composed of thin separable laminæ, lying generally in obliquely horizontal directions over each other, admit these waters to pass on by gradual but constant percolation. Thus collecting and associating, they augment and form little rills, brooks, and even subter-

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* Dublin, 1793, p. 223 et seq.

raneous rivers, which wander in darkness beneath the surface of the earth, by innumerable doublings, windings, and secret labyrinths; no doubt in some places forming vast reservoirs and subterranean lakes, inhabited by multitudes of fish and aquatic animals: and possibly when collected into large rapid brooks, meeting irresistible obstructions in their course, they suddenly break through these perforated fluted rocks, in high perpendicular jets, nearly to their former level, flooding large districts of land. Thus by means of those subterranean courses, the waters are purified and finally carried to the banks of great rivers, where they emerge and present themselves to open daylight, with their troops of finny inhabitants, in those surprising vast fountains near the banks of this river."

The clearness of the water appears to me capable of farther elucidation; and the explanation here suggested, if correct will apply to all the fountains and lakes in that country. The samples taken from the Suannee spring, as has already been remarked, are bronzed over with a coating of sulphuret of iron, thus evincing the presence of sulphuretted hydrogen. Indeed the odor of this gas is often spoken of as being very perceptible at the surface of these springs. The waters before, or as they approach the surface of the ground in their course, become more or less impregnated with salts of iron, which are constantly decomposed by the sulphuretted hydrogen,—the sulphuret of iron subsiding to the bottom, coating whatever substances it may meet, and leaving the supernatant fluid perfectly colorless. Thus its waters are freed from all metallic traces, whose presence in water invariably produces along with the vegetable infusions incidental to small rivers and lakes, a dark, reddish-brown color.

But to give a short description of the Suannee spring :—The banks of the river are about thirty feet high in the immediate neighborhood of the spring. Between the river and the spring, however, when the stream is not unusually swollen, is a natural bridge, thirty or thirty-five feet wide, under which the water discharged finds its way to the river. The surface of the spring is fifty feet over, and the usual depth fourteen feet. The water comes to the surface under an angle of 60° ; and the quantity discharged is variously estimated at, from twenty, to one hundred hogsheads per minute. In order to prevent persons, bathing or diving in the spring, from being carried through the tunnel into the river, a lattice of timbers is placed across its mouth. In consequence of the nearly vertical discharge of the water, it is a favorite amusement to dive into the fountain in the direction of the issuing stream, which instantly brings the diver to the surface. When the river is much swollen by freshets, the mouth of the spring and the surface of the bridge are many feet beneath the level of the river. I could learn nothing satisfactory concerning the temperature of the water.

Other fountains in some respects, still more remarkable, have been described to me as existing upon the St. Johns; but before alluding to them, it may be worth while to quote the accounts of a few, as given by Bartram in his travels above alluded to. This traveller and naturalist observes during his solitary voyage upon the St. John, while crossing that expansion of this stream, called Lake St. George,

"The morning being clear, I set sail with a favorite breeze, coasting along the shores; when on a sudden the waters became transparent, and discovered the sandy bottom, and the several nations of fish, passing and repassing each other. Following this course I was led to the cape of the little river, descending from Six Mile Springs, and meandering six miles from its source through green meadows. I entered this pellucid stream, sailing over the heads of innumerable squadrons of fish, which, although many feet deep in the water, were distinctly to be seen." p. 157.

Having landed and taken a position for observing the spring to the best advantage, he continues,

"Just under my feet, was the inchanting and amazing crystal fountain, which incessantly threw up, from dark, rocky caverns below, tons of water every minute, forming a basin, capacious enough for large shallops to ride in, and a creek of four or five feet depth of water, and near twenty yards over, which meanders six miles through green meadows, pouring its limpid waters into the great Lake George, where they seem to remain pure and unmixed. About twenty yards from the upper edge of the basin, and directly opposite to the mouth or outlet of the creek, is a continual and amazing ebullition, where the waters are thrown up in such abundance and amazing force, as to jet and swell up two or three feet above the common surface: white sand and small particles of shells are thrown up with the waters, near to the top, when they diverge from the centre, subside with the expanding flood, and gently sink again, forming a large rim or funnel round about the aperture or mouth of the fountain, which is a vast perforation through a bed of rocks, the ragged points of which are projected out on every side. Thus far I know to be matter of real fact, and I have related it as near as I could conceive or express myself. But there are yet remaining scenes inexpressibly admirable and pleasing.

"Behold, for instance, a vast circular expanse before you, the waters of which are so extremely clear as to be absolutely diaphanous or transparent as the ether; the margin of the basin ornamented with a great variety of fruitful and floriferous trees, shrubs and plants, the pendant golden orange, dancing on the surface of the pellucid waters, the balmy air, vibrating with the melody of the merry birds, tenants of the encircling aromatic grove.

"At the same instant innumerable bands of fish are seen, some clothed in the most brilliant colors; the voracious crocodile stretched along at full length, as the great trunk of a tree in size; the devouring garfish, inimical trout, and all the varieties of gilded painted bream; the barbed catfish, dreaded sting-ray, skate, and flounder, spotted bass, sheeps head and ominous drum; all in their separate bands and communities, with free and unsuspicious intercouse performing their evolutions; there are no signs of enmity, no attempt to devour each other; the different bands seem peaceably and complaisantly to move a little aside, as it were to make room for others to pass by.

"But behold yet something far more admirable, see whole armies descending into an abyss, into the mouth of the bubbling fountain: they disappear! are they gone forever? is it real? I raise my eyes with terror and astonishment; I look down again to the fountain with anxiety, when behold them as it were emerging from the blue ether of another world, apparently at a vast distance; at their first appearance, no bigger than flies or minnows; now gradually enlarging, their brilliant colors begin to paint the fluid.

"Now they come forward rapidly, and instantly emerge, with the elastic expanding column of crystalline waters, into the circular basin or funnel: see now how gently they rise, some upright, others obliquely, or seem to lie as it were on their sides, suffering themselves to be gently lifted or borne up by the expanding fluid towards the surface, sailing or floating like butterflies in the cerulean ether; then again they as gently descend, diverge and move off; when they rally, form again, and rejoin their kindred tribes.

"This amazing and delightful scene, though real, appears at first but as a piece of excellent painting; there seems no medium; you imagine the picture to be within a few inches of your eyes, and that you may without the least difficulty touch any one of the fish, or put your finger upon the crocodile's eye, when it really is twenty or thirty feet under water.

"And although this paradise of fish may seem to exhibit a just representation of the peaceable and happy state of nature which existed before the fall, yet in reality it is a mere representation; for the nature of the fish is the same as if they were in Lake George or the river; but here the water or element in which they live and move, is so perfectly clear and transparent, it places them all on an equality with regard to their ability to injure or escape from another; (as all river fish of prey, or such as feed upon each other, as well as the unwieldy crocodile, take their prey by surprise; secreting themselves under covert or in ambush, until an opportunity offers, when they rush suddenly upon them:) but here is no covert, no ambush; here the trout freely passes by the very nose of the alligator, and laughs in his face, and the bream by the trout.

"But what is really surprising is, that the consciousness of each other's safety, or some other latent cause, should so absolutely alter their conduct, for here is not the least attempt made to injure or disturb one another." p. 166.

The same author describes another spring about one hundred miles higher up the St. John, and about thirty miles from New Smyrna,

"Which issued from a high ridge or bank on the river, in a great cove or bay, a few miles above the mouth of the creek which I ascended to the lake; it boils up with great force, forming immediately a vast circular basin, capacious enough for several shallops to ride in, and runs with rapidity into the river three or four hundred yards distance. This creek, which is formed instantly by this admirable fountain, is wide and deep enough for a sloop to sail up into the basin. The water is perfectly diaphanous, and here are continually a prodigious number and variety of fish; they appear as plain as though lying on a table before your eyes, although many feet deep in the water. This tepid water has a most disagreeable taste, brassy and vitriolic, and very offensive to the smell, much like bilge water or the washings of a gun-barrel, and is smelt at a great distance. A pale bluish or pearl colored coagulum covers every inanimate substance that lies in the water, as logs, limbs of trees, &c. Alligators and gar were numerous in the basin, even at the apertures where the ebullition emerges through the rocks; as also many other tribes of fish. In the winter season several kinds of fish and aquatic animals migrate to these warm fountains. The forbidding taste and smell of these waters seems to be owing to vitriolic and sulphureous fumes or vapors; and these being condensed, form this coagulum, which represents flakes of pearly clouds in the clear cerulean waters in the basin." p. 143.

I cannot omit Bartram's description of the Mannate spring, situated four miles from Tallahassee.

"The ebullition is astonishing, and continual, though its greatest force of fury intermits, regularly, for the space of thirty seconds of time: the waters appear of a lucid sea green color, in some measure owing to the reflection of the leaves above: the ebullition is perpendicular upwards, from a vast ragged orifice through a bed of rocks, a great depth below the common surface of the basin, throwing up small particles or pieces of white shells, which subside with the waters at the moment of intermission, gently settling down round about the orifice, forming a vast funnel. At those moments, when the waters rush upwards, the surface of the basin immediately over the orifice is greatly swollen or raised a considerable height; and then it is impossible to keep the boat or any other floating vessel over the fountain; but the ebullition quickly subsides; yet, before the surface becomes quite even, the fountain vomits up the waters again, and so on perpetually. The basin is generally circular, about fifty yards over; and the perpetual stream from it into the river is twelve or fifteen yards wide, and ten or twelve feet in depth; the basin and stream continually peopled with prodigious numbers and variety of fish and other animals; as the alligator, and the manate or sea cow, in the winter season." p. 229.

A very remarkable spring was described to me by Major Smith, of the U. S. Army, as existing upon the Ocklewaha river, thirty or forty miles from the St. John, and distant seventy miles in a line from St. Augustine, or one hundred and forty-five, by the way of Jacksonville. The spring is forty feet deep, and three hundred wide; and gives rise to a rapid creek fifteen or twenty yards wide, and twenty-five feet deep. The waters of this fountain are described as equalling in transparency those above alluded to.

The Sulphur springs upon the St. John, in the neighborhood of Lake George, are distinguished for their sulphuretted impregnations. A thermometer plunged into these waters when the temperature of the air was 34°, stood at from 56° to 60°.

Besides these boiling fountains, there exist many inland lakes or ponds, the depths of whose waters, in many instances, has not been ascertained, and which are regarded by the inhabitants as unfathomable; they are all equally remarkable for their transparency. Indeed the same feeling is produced in the minds of the inexperienced when sailing upon them as is described to have been felt by sailors in the clear waters of the northern seas—the sensation of being suspended in mid-air, rather than of floating upon the surface of water.

Those geologists whose theories lead them particularly to the study of the causes now in action which modify the earth's surface, would find in the frequently recurring sinks as they are called, and in the occasional outbreaking of fountains, almost peculiar to this country abundant materials for reflection. The causes of the sinks, are no doubt, correctly apprehended, in the prevailing opinion, that they are occasioned by the underground passage of large bodies of water, traversing a weak and cavernous rock. Bartram has given one account, the subject of which is near Tallahassee, which I think deserves to be revived at this time.

"Next day early in the morning we left the town and the river, in order to fix our encampment in the forests about twelve miles from the river; our companions with the pack-horses went a-head to the place of rendesvous, and our chief conducted me another way to show me a very curious place, called the Alligator-Hole, which was lately formed by an extraordinary eruption or jet of water. It is one of those vast circular sinks, which we beheld almost every where about us as we traversed these forests, after we left the Alachua savannah. This remarkable one is on the verge of a spacious meadow, the surface of the ground round about being uneven by means of gentle rising-knolls: some detached groups of rocks and large spreading live oaks shade it on every side: it is about sixty yards over, and the surface of the water six or seven feet below the rim of the funnel or basin; the water is transparent, cool, and pleasant to drink, and well stored with fish; a very large alligator at present is lord or chief; many have been killed here, but the throne is never long vacant, the vast neighboring ponds so abound with them.

"The account that this gentleman, who was an eye-witness of the last eruption, gave me of its first appearance, being very wonderful, I proceed to relate what he told me whilst we were in town, which was confirmed by the Indians, and one or more of our companions, who also saw its progress, as well as by my own observations after I came to the ground.

"This trader being near this place (before it had any visible existence in its present appearance,) about three years ago, as he was looking for some horses which he expected to find in these parts, on a sudden was astonished by an inexpressible rushing noise, like a mighty hurricane or thunder storm; and looking round, he saw the earth overflowed by torrents of water, which came, wave after wave, rushing down a vale or plain very near him, which it filled with water, and soon began to overwhelm the higher grounds, attended with a terrific noise and tremor of the earth. Recovering from his first surprise, he immediately resolved to proceed for the place whence the noise seemed to come; and soon came in sight of the incomparable fountain, and saw, with amazement, the floods rushing upwards many feet high, and the expanding waters, which prevailed every way, spreading themselves far and near. He at length concluded (he said) that the fountains of the deep were again broken up, and that an universal deluge had commenced; and instantly turned about and fled to alarm the town, about nine miles distance: but before he could reach it, he met several of the inhabitants, who already alarmed by the unusual noise, were hurrying on towards the place; upon which he returned with the Indians, taking their stand on an eminence to watch its progress and the event. It continued to jet and flow in this manner for several days, forming a large, rapid creek or river, descending and following the various courses and windings of the valley, for the distance of seven or eight miles, emptying itself into a vast savannah, where was a lake and sink which received and gave vent to its waters.

"The fountain, however, gradually ceased to overflow, and finally withdrew itself beneath the common surface of the earth, leaving this capacious basin of waters, which, though continually near full, hath never since overflowed. There yet remains, and will, I suppose, remain for ages, the dry bed of the river or canal, generally four, five, and six feet below the natural surface of the land; the perpendicular, ragged banks of which, on each side, show the different strata of the earth; and at places, where ridges or a swelling bank crossed and opposed its course and fury, are vast heaps of fragments of rocks, white chalk stones, and pebbles, which were collected and thrown into the lateral vallies, until the main stream prevailed over and forced them aside, overflowing the levels and meadows, for some miles distance from the principal stream, on either side. We continued down the great vale, along its banks, quite to the savannah and lake where it vented itself, while its ancient subterranean channel was gradually opening which, I imagine, from some hidden event or cause had been choaked up, and which, we may suppose, was the immediate cause of the eruption." p. 238.

I have been the more particular in collecting the foregoing facts relative to the Hydrography of the Floridas, in order that it may be perceived how much interest attaches to the subject, and how much we yet stand in need of farther information.

Art. XXII.—*Miscellaneous Notices respecting Cholera.**

1. *Essay on the Epidemic, usually called Asiatic Cholera, &c.;* by Thomas Spencer, M. D.

This is a pamphlet of one hundred and thirty pages, giving at large the author's views of the epidemic cholera, as it appeared in the interior of the State of New York. It is in the form of an address to the Medical Society of that State, of which Dr. Spencer is President.

A principal object of the essay is to prove that the disease, instead of being a *Cholera*, as it was extensively considered in the East; or a malignant fever, of which the symptoms affecting the alimentary canal, constitute but one stage, as it has been thought to be by many perhaps most European and American physicians, is essentially a *diarrhœa*, and should be named, *diarrhœa serosa.* This opinion is with much ingenuity, sustained, throughout the essay. In accordance with this opinion, he considers the discharge from the intestinal canal, of a peculiar fluid, under particular circumstances, as the essential and pathonomonic symptom of the disease. This peculiar symptom, he believes to have been co-extensive with the epidemic influence, and in many places, where this influence was weak, or unaided by powerful exciting causes, to have constituted the whole of the disease. The characteristic marks of this diarrhæa, are, the absence of bile from the evacuations, preceded or accompanied by a white slimy tongue; distress at the pit of the stomach and indigestion; slight abdominal pain, emaciated expression of countenance, prostration of strength, and indisposition to corporeal and mental exertion. Many other symptoms, which are known to be present, in a large proportions of severe cases, as vomitings, spasms, suppression of urine, coldnesss and peculiar color of the surface, diminished action of the circulating system, &c. are considered as secondary and unessential to the character of the disease.

The following propositions laid down by the author as a summary of the pathology of the second stage of the disease, or that stage which immediately precedes collapse, will give a better view of his notions concerning its nature, than can be derived from any other extract of the same extent.

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* These notices, prepared for the preceding No. by a valued medical friend, were excluded, for want of room, and the same reason now prevents the addition of other similar notices of works since received,—among which, is one by Mr. Daniel Drake, of Cincinnati.—*Ed.*

"1. The disease essentially consists in this stage, in a determination of fluids to the inner surface of the small intestines, diverting the respiratory, perspiratory and urinous discharges, with their neutral salts, from their usual channels; *and discharging them through the intestinal exhalents*, rapidly emptying the blood vessels of their contents, and changing the relative proportions of the remnant of circulating fluids.

"2. That the failure of the functions of the heart, lungs, capillary circulation, and various secretions, results from direct depletion, depriving those organs of their accustomed stimulus.

"3. The absorbent system is rapidly taking up the adipose and waste parts of the body, to supply the failing resources of the heart, and thus results the rapid emaciation.

"4. The spasms of the voluntary muscles, and those drawn into contractions in the act of vomiting, by compressing the intestinal exhalents, tend to arrest the discharges; and by aiding the return of the venous circulation, stimulate the heart to redoubled exertion, giving a centrifugal direction to the circulation, thereby making a metastasis of the exhalation from the inner surface of the bowels to the skin.

"5. That a striking analogy exists between this disease and hemorrhage, differing only in its effects upon the constitution, from the circumstance of its changing the relative proportions of the ingredients of the blood."

From this summary it will be seen that Dr. Spencer considers the exhalent tissue of the intestinal canal to be the proximate seat of the disease, and to the restoration of this tissue to the healthy performance of its functions, his remedies are directed. The indications which he lays down for the treatment of the second stage of the disease, will convey a just view of the remedial measures which he recommends.

These indications are,

"1. To arrest the intestinal discharge.

"2. To make a transfer of the serous discharges from the exhalents of the bowels to those of the external surface.

"3. To restore the lost balance and healthy performance of the various excretory and secretory functions.

"4. To support the powers of the system, and combat incidental symptoms."

To fulfil the three first indications, he relies principally upon a combination of active emetics and sudorifics. The point upon which he insists the most strongly, is the prompt and active employment of emetics, and exciting the action of the skin by a diaphoretic regimen. In the stage of collapse, he relies upon a mild stimulating treatment such as most practitioners would employ in a case of exhaustion from hemorrhage, or any other wasting evacuation.

The object aimed at by Dr. Spencer, is, by fixing the character of the disease, and by pointing out the symptoms which characterize it through its whole course, and especially in its early stages, to afford the means of a ready diagnosis, and to ascertain the remedial measures which will arrest it, before it has advanced to its last, and too often fatal period.

This object, it will be agreed by all, is of the highest importance; of great importance in all epidemics, and especially in this, on account of the great mortality, a mortality almost undiminished by any peculiar mode of treatment, of the cases which have been suffered to go on to the advanced stages of the disease.

In the accomplishment of this object, after discussing the subject of the name, the pathology, and the treatment of the first stage of the disease, Dr. Spencer has treated, at large, of the individual and public means of preventing the epidemic. The rules which he lays down under these heads are highly judicious, and deserve the attention of individuals and public bodies.

Whatever may be thought of Dr. Spencer's peculiar notions concerning this disease, all will probably agree that his remarks upon it evince much candor and ingenuity.

2. *Letters on Cholera Asphyxia as it has appeared in the city of New York; addressed to John C. Warren, M. D. &c.* by Martin Payne, M. D.

In these letters, which were written by Doct. Payne to his medical instructor, the author has shown himself to be an accurate observer, and a distinct, unbiassed and intelligent narrator of the phenomena which occurred in New York during the prevalence in that city of the epidemic, which he calls Cholera Asphyxia. The symptoms which characterized the disease in that city are the same as have been described as existing wherever the disease has appeared in a severe form. The several stages of the disease, with the peculiar symptoms of each, as well as the best mode of treating it, are described with much clearness and accuracy.

Some of the prominent circumstances brought forward by Doct. Payne, though not considered by him as peculiar to the epidemic in New York, are,

1st, The mildness of the train of symptoms immediately preceding the dangerous state of collapse. These symptoms were principally such as "denote some impaired function of the digestive organs, and usually consist of diarrhœa, frequently connected with nausea and vomiting." This state of impaired function, during the prevalence of the epidemic influence, is excited by the slightest application of the ordinary exciting causes of disease in the digestive organs. Still, in the opinion of Doct. Payne, this state of the bowels is not cholera; nor does he believe the disease when fully formed, to be seated in the mucous membrane of the intestinal canal, or in the adjacent glands. As the name which he has selected indicates, he considers the disease to be a general one, the distinguishing symptom of which is seated in the blood vessels, "a fever, of which the collapse is the first stage, and reaction the second."

2d, The suddenness of the attack of the disease, or of the collapse, and the disproportion between its violence and the exciting causes. These may be merely a slight excess in the quantity of food or drink, or the indulgence in articles of diet at other times perfectly harmless, yet the effects such as to prove fatal in a few hours.

3d, The necessity, resulting from the fact just stated, of great caution in many of the common articles of food, and of restricting the diet to a small number of the least irritating substances.

4th, The great apathy, after the attack of the disease, both of body and mind, to all ordinary impressions. The mind, although conscious of the presence of danger, remained unmoved; and the body, although sensible to the impression of remedial agents, afforded no reaction. Sensibility remained, while irritability was destroyed.

5th, The great diversity of remedial measures which were resorted to. Here, as elsewhere, every plan of treatment which ingenuity could devise, or credulity confide in, was adopted. How far this diversity arose from the want of success of all; and how far from a sort of undefined expectation on the part of medical men, of hitting upon some specific, for what appeared to be beyond the reach of ordinary remedies, is uncertain. If physicians, instead of looking out for extraordinary or specific modes of treatment, had confined themselves to those general principles which wisdom has discovered, and experience sanctioned in other diseases, making all due allowance for the almost unequalled severity of this, they would probably have been, at the least; equally successful. It is the opinion of Doct. Payne, that not more than one patient in six of asphyxiated cholera recovers, under any treatment.

Many other topics of interest are considered in this treatise. There will be found, especially in the sixth letter, a full, accurate and intelligible account of the various symptoms, both ordinary and irregular, during life, and of the appearance of all the important parts of the body after death.

One fact, hitherto unnoticed, is stated on the authority of Doct. Gale. This is, the presence of a small quantity, varying from one half to two per cent, of an oily matter, floating on the blood, taken from some of the most important organs, of a portion of cholera patients after death. No opinion is given concerning the origin of this fluid, nor any conjecture of its effects upon the system.

These letters will be read with pleasure by those who desire an accurate account of the cholera as it appears in this country.

3. *Some account of the Asiatic Cholera, Cholera Asphyxia, &c., by* SAML. A. CARTWRIGHT, M. D. of Natchez.

This is a pamphlet, of more than thirty pages, prepared and published by the author, in compliance with repeated solicitations of his friends, physicians and others, for such rules of diagnosis and treatment as would guide them on the first breaking out of the disease, which it was apprehended would ravage the southern section of this country. His object has been to give such a plain account of the disease, and of the mode of treatment, as would be available to gentlemen out of the profession, as well as to those belonging to it.

The remarks of Doct. Cartwright are always pertinent to the subject in hand : and in this treatise he has compressed much information into a narrow compass. He, in the first place, gives a brief account of the disease, as it has appeared in the various countries over which it has passed ; enumerates some of the causes to which it has been attributed, giving it as his opinion, that it is owing to a *moving, non-electric meteor ;* describes with sufficient accuracy the prominent symptoms : mentions the practice of authors of the greatest experience and celebrity, and indicates the treatment which accords best with his notions of the pathology of the disease. Concerning the last particular, he observes, that " the disease consists in a constant tendency to a failure of the circulation, and all its fatal symptoms are based upon this failure;" and that "the *one* main indication to be fulfilled, is, *to keep up the circulation, and prevent the blood from stagnating in the veins.*" This indication he endeavors to fulfil by various methods in the different stages. When collapse is present, he adopts the plan recommended by Mr. Baird, of overcoming the spasm of the heart, by the use of tobacco as an enema. Before the stage of collapse, he relies principally on mustard, and saline emetics, and blood-letting. Many other auxiliary medicines are advised, with no great peculiarity as to kind or mode of administration, when compared with other writers upon this subject.

4. *A rational view of the Spasmodic Cholera, chiefly with regard to the best means of preventing it.* By A Physician. Boston.

This pamphlet is made up principally of extracts from the various publications which were made soon after the breaking out of the cholera in this country. The object of the author was to select such plain practical rules, as might be easily understood, and made available by the public at large, for the prevention of cholera, and for the treatment of it, when professional advice could not be obtained. The work, when it was published, was well timed and useful, as the selection was judiciously made, and the rules recommended, such as are now generally understood to be the most efficient in guarding against that mysterious agency which predisposes the human system to this disease.

5. *Account of the cases of Cholera, observed among the Physicians and persons employed in the Hospitals in the provinces of Prussia.* By Dr. W. Wagner. (Extracted from the Archives du Cholera, 2d No. Berlin: 1832.)

(Translated for this Journal, by J. H. Griscom, M. D.)

According to the reports of the central police, published up to this day, (3d of April, 1832,) the number of cases of cholera observed among the physicians, surgeons, overseers, carriers of the sick, grave diggers, &c. has been four hundred and seventy six, of whom two hundred and seventeen recovered, and two hundred and fifty nine died; in this total are comprised the cases observed at Berlin, and in the provinces of Bromberg, Posen, Gumbinnen, Marienwerder, Oppeln, Căslin, Stettin, Kœnigsberg, Dantzig, Potsdam, and Magdebourg.

At Berlin, ninety seven persons employed in taking care of the sick, were attacked with cholera; of this number, seventy were cured, and twenty seven died; of these, eight were physicians, two surgeons, sixty five overseers, seven carriers of the sick, one inspector of the lazaretto, one director of quarantine, three watchmen, one bather, one corpse watcher, two bearers of the dead, two washerwomen, and one laborer. The recoveries are distributed as follows, in these different classes; seven physicians, one surgeon, forty seven overseers, two carriers of the sick, and three grave diggers. Consequently, there died, one physician, one surgeon, eighteen overseers, five carriers of the sick, &c.

The province of Bromberg has furnished twenty nine patients, among the persons employed to attend to the cholerics; of these, two were physicians, who recovered, six surgeons, of whom but one died, twenty overseers, of whom nineteen were cured, and one carrier of the sick, who sank under the disease.

In the province of Posen were counted forty cases, of which nine recovered and thirty one died; among eight physicians and surgeons who fell sick, five of the former and one of the latter recovered; the others were victims to their zeal. Of twenty two overseers, nineteen fell victims; likewise six grave diggers, one body watcher, one carrier of the sick, one boy of the amphitheatre, and one laborer.

The province of Oppeln had to deplore the loss of seven persons, two surgeons, four overseers, and one carrier of the sick. The whole number of sick in the province of Stettin was twenty; these were eleven overseers, two carriers of the sick, six grave diggers, and one employed in the *Cordon Sanitaire.* Thirty nine persons of the province of Gumbinnen were attacked with cholera, two physicians, who recovered, five surgeons, of whom two died, seventeen overseers, of whom only three were saved, twelve carriers of the sick, of whom nine died, and three grave diggers, none of whom recovered. In the province of Marienwerder, of nineteen sick, there were three physicians, twelve overseers, three grave diggers, and one servant boy; the recoveries were seven, one physician, five overseers, and one grave digger. The province of Kœnigsberg had one hundred and five sick among those employed to take care of the cholerics; these were, four physicians, four surgeons, one inspector of the lazaretto, seventy one stewards or matrons, twelve carriers of the sick, and eight grave diggers. The dead were, two physicians, one surgeon, forty stewards or matrons, nine carriers of the sick, and eight grave diggers.

In the province of Dantzig, were counted seventy nine cases and fifty one deaths. The sick were, five physicians and surgeons, fifty nine stewards, three carriers of the sick, and twelve grave diggers or carriers of the dead. Of this number, three physicians, thirty six stewards, two carriers of the sick, and ten grave diggers, died. The number of sick in the province of Potsdam was fifteen, of whom twelve died and three recovered; the deaths were, one surgeon, eight overseers, two inspectors of quarantine, and one washer-woman of the cholera hospital.

Finally, the epidemic commencing in the province of Coslin, has already caused the death of one overseer at Lauenbourg.

Such is the summary of the cases observed up to the 3d of April, 1832, in the Prussian provinces; it results from this sketch, that the persons employed around the cholera patients, have less chances of recovery than of dying, when they contract the disease, and that in the proportion of two hundred and seventeen to two hundred and fifty nine; that is to say, there are about four cures for five deaths. We have not here the total number of persons employed in the hospitals, in order to ascertain the proportion of those attacked with those who are not; but as we have already given that of Berlin, we may suppose that it is the same in the other cities, that is, about *forty times* greater than the mass of the population. In fact, we have seen, at Berlin, the forty one hundredth part of those employed in the hospitals contract the cholera, while among the population there was but one case for every three hundred inhabitants.* The deductions from these facts are too evident to render it necessary to express them here. We will submit it to the non-contagionists, whether they can explain them upon the supposition of its being a purely epidemic disease.—*Bib. Univ. Aout*, 1833.

6. *Remarks on Cholera, and other topics, in a letter dated Hampstead, near London, Nov.* 1832, *and addressed to the Editor.*

Cholera—its habitudes.—From all I learn, the experience of our English Physicians has made but *little* improvement in the treatment

* See the No. for December, 1832.

of the disease or knowledge of its origin. I think the following conclusions may be relied upon as far as relates to England. The sides of rivers and the vicinity of low marshy grounds were the chief seats of the disease. In towns which were somewhat elevated above the river level, it was chiefly in those streets that descended to the river that the cholera prevailed. Chalk soils and dry sandy soils seem to have been peculiarly exempt from cholera. There has not been one case of Indian Cholera in the whole county of Sussex. At Hampstead, though so near London, we had only two cases and these were of persons who resided the greater part of the day in London. Hampstead contains 8000 inhabitants, it is upon the London clay chiefly, but this is much mixed with sand and we are elevated from 300 feet to 350 feet above the Thames.

Medical Geology.—At some future day, I have no doubt, that we shall discover that there is such a science as medical geology, viz. that certain strata are, as foundation ground for human habitations, much more liable to be affected with certain causes of diseases than others, and we shall probably not only know the fact, but ascertain the cause and the remedy. The county of Norfolk has long been famous or infamous for the astonishing number of patients affected with the stone, nothing has hitherto been done to investigate the cause. The earth, I have long since been persuaded, contains within itself agents destined to affect future changes of the solid surface, and also of the atmosphere. The pestilence and earthquake which reigned together, for seventy years during the reign of Justinian, and depopulated the fairest portion of the civilized world—were doubtless the result of certain subterranean laws, which regulate its internal economy—laws known only to its creator.

Celestial Phenomena.—Beside the cholera, we have in Europe, been terror-stricken by the comet, which passed the earth's path in October. You are, no doubt, well acquainted with Arago's popular essay on comets ; I am however by no means convinced that the chances of the earth or atmosphere being affected by the near approach of a comet are so slight as he would have us believe. In the section of the essays on the four new planets, " that move round the sun in nearly the same time and distances, he agrees with other astronomers in supposing they may all be some broken parts of one planet—and that this may have been effected by a comet, or by an internal explosion, but then the difficulty he says is in supposing how it should happen that while three of these planets have taken a large portion of the old atmosphere and divided it amongst them, poor Vesta is left without any visible envelope, purely naked. This puzzles Mr. Arago very much. Mr. Herapath, an English first rate mathematician, who for some cause or other is not in good odor with the Royal Society, has published in the Times Newspaper of last month, (October) a letter in which he most ingeniously proposes an hypothesis in itself extremely rational, which is that Vesta was the satellite of the old planet, an hypothesis which the different period of its revolution and the difference in the elements of its orbit tend strongly to confirm.

Atmospheres of Planets.—The atmosphere of our own moon is so extremely rare, low, and transparent, that its existence was long doubted or denied. I have, this year, had the good fortune in our murky atmosphere to catch two glimpses of Mercury on the sun's disk, which very few persons in England saw. One occultation of Saturn by the moon, very perfect, one of Aldebaran during broad sunshine; and the planet Saturn without any vestige of its ring, looking as much shorn of its glory, as an English judge would be when deprived of his robes and wig. I think Mr. Herapath's hypothesis respecting Vesta well deserves a place in your Journal, with the brief section on the new planets by Arago, in the Annuaire du Roi. To descend from the Heavens to the earth.

Tertiary Formations.—The greatest advance recently made in Geology, that I am acquainted with, is the discovery of the wide spread extent of tertiary formations, analogous, though perhaps not identical with the tertiary beds of France and England. In this discovery your country bears a full share; there can be little doubt that the organic remains sent from the United States, are analogous to those in the European beds, and also to those in part of the chalk formation.

Supposed Immutability of Species.—With respect to the immutability of species it may be true in the higher orders of animals, but in Mollusca having no internal skeleton, I am fully persuaded that change of circumstances may produce important changes of form, changes quite sufficient to make our Cabinet Philosophers regard them as distinct species; but nature is not restricted by these artificial arrangements.

MISCELLANIES.

FOREIGN AND DOMESTIC.

Extracted and translated by Prof. J. Griscom.

1. *Death of Scarpa.*—At Pavia in Italy, has just been extinguished the most brilliant light of modern surgery, and of all the sciences accessory to this part of the healing art; Scarpa, at the age of eighty five years, expired on the 31st of October, 1832.

During many years, Professor and Director of the University of Pavia, he constituted the glory of this school, and spread over it the influence of his great reputation. Gifted with a rare genius, there is no branch of surgery, in which he did not make some progress, few discoveries in anatomy, or pathology, to which his name was not attached. He may be regarded as the first who drew attention to pathological anatomy, perhaps as the creator of this important part of medicine.

Indefatigable in his researches, he never, during his long, and yet too short career, ceased to labor for the advancement of science; and he never labored without attaining his end. His style of writing was clear, concise, and vigorous. Nothing is more elegant, more amiable, than his epistolary style: his eloquence was Ciceronian. When to the charm of language, we add the talent of the most exact and most veracious observer, the address and good fortune of one of the greatest operators, and then the frank publication of all that was done and seen, we may attach to his works the motto, *Exegi monumentum ære perennius.*

If I am not mistaken he began his career by a work upon the diseases of the eyes, which was immediately translated into all the languages of Europe; a fifth edition of it was given in 1816; this edition which he brought to the level of all the new discoveries was augmented by four important chapters, one upon the artificial pupil, one upon the medullary fungus of the eye, the third upon the cancer of the eye, and the fourth upon the cystic tumor, which is formed in the cavity of the orbit. When we read, or rather when we study this beautiful work, and we know how extended and fortunate was his practice in this branch, we might imagine that Scarpa, was exclusively occupied with the diseases of the eye, and that his vocation was that of an oculist.

He has published many little works upon this subject and among others a series of letters, addressed to the author of this notice, in which he endeavors to prove that the operation of cataract by displacement, or depression, is preferable to extraction. It is probable that if he had had less success in practising upon his favorite method, he would have been less eloquent in establishing its superiority.

Scarpa was forty five years of age, when he published his work, entitled: *Tabulæ neurologicæ ad illustrandam historiam anatomicam cardiacorum nervorum noni nervorum cererib, glossopharingæi, et pharingæi ex octavo cerebri.* He designed himself, the models which the engraver has copied with a profusion of care and talent, such as until that that time, nothing had been seen to compare with in point of magnificence, and which has been scarcely equaled in perfection. The only fault to be found with this magnificent work is, that its price renders it inaccessible to common surgeons.

In 1814, he published in folio his great work upon aneurism; on this he lavished the same profusion of engravings; but it was too important, too useful, to remain merely an ornament to large libraries; it was translated into several languages, and this eminently classical treatise, reduced to the form of 8vo. has been placed in the hands of every master and every student.

In 1815, Scarpa, gave the public a memoir or appended it to his work upon aneurism, in which we find the details of a series of trials of the ligature on the arteries of different animals, suggested by reading the work of Jones, whose experiments he varied and multiplied. This memoir, rich in facts and observations, as important as curious, produced a great number of partisans to his method of tying the artery in aneurism, which consists in flattening the artery, with a cylinder, in a manner to avoid rupturing and bruising it.

The treatise upon hernia, the second edition of which was printed in 1819, since it has been translated and reduced to the ordinary form, has become the *vade mecum* of every surgeon. I would likewise speak of a work upon the anatomy and physiology of the ear, upon osteogeny; of numerous polemical memoirs, relative to a great number of subjects, but chiefly relative to his dispute with Vacca Berlinghieri, who endeavored to establish his *Rectos-vesicale* method in the operation of Lithotomy; but I should be led further than this short announcement will permit. It was proper, after having enjoyed his correspondence for a great number of years, and at the time when Prof. Mauro Rusconi, informed me that I had just lost this friend, that I should give this public testimonial of my respect, my admiration and my regrets. Perhaps I may, at some later period, state in a more complete manner, the right of Scarpa, to the homage of posterity. J. P. M.

2. *Death of Oriani.*—The capital of Lombardy, lost on the 12th November last, Count *Barbana Oriani,** who may be justly considered as one of those rare and eminent men, who by their talents are regarded as the ornaments of Italy. We are indebted to this celebrated astronomer, for many profound memoirs upon theoretical and practical astronomy, printed in the valuable collection of the *Ephemerides* of Milan. Oriani first determined the orbit of the planet Uranus, and the perturbations of the new planets. The theory of astronomical refraction is indebted to him for an important step which has opened the way for those who have subsequently treated of this subject.

His work entitled *Trigonometria spheroidica* has become classic: in this discovery the great astronomer is worthy of being associated with the greatest geometricians of Europe. Other details upon his works, and upon the circumstances of his life belong to his biography.

Oriani, died an octogenarian, warmly regretted by his friends and by the admirers of his genius. The brilliant qualities of his heart have been justly appreciated by all those who have shared in the honor of an intimate acquaintance; they justify the high consideration and the great credit which he enjoyed in his own country. An enlightened protector of the youth who sought in him a support, he knew how to forget in their presence, all his superiority, and to show himself their zealous friend. Always simple and accurate, in his conversation, he inspired them with feelings of gratitude and an attachment as durable as respectful.

The latter days of his life exhibited in the midst of his sufferings, the spectacle of a tranquillity of soul, worthy of the christian philosopher. Oriani, rejoiced in the propagation of knowledge, which he regarded as an efficacious means of ameliorating the human species; he considered the acquisition of principles in the exact sciences, as alone indestructible, amid the variations and errors of the human mind. All the friends of science will honor the memory of this man

* Count Oriani, was known in his youth, under the title of the Abbe Oriani.

equally distinguished for his extraordinary talents, and for the purity of his character.—*Bib. Univ.*

3. *Experiments and Observations on the Torpedo; by Dr. Davy.*—Sir. H. Davy, published in the Philosophical Transactions, for 1829,* a memoir upon some experiments which he had made on the Torpedo, with a view to ascertain how far the electricity of this animal is analogous to voltaic or galvanic electricity; but his results were, in general, of a negative character. The declining state of his health hindered him from pursuing this research, which he had ardently desired to complete, and which he recommended to his brother to continue after his death. In conformity to this wish, the author being at Malta, in a situation favorable for procuring living torpedoes, made the series of experiments contained in a memoir, which he read to the Royal Society of London, on the 22d of March, and 12th of April, 1832. They entirely confirm those made by Mr. Walsh, in 1772, which established the analogy of the action exerted by the fish with that of ordinary electricity; they prove also that like voltaic electricity, this action has the power of communicating to steel, magnetic polarity, of causing a deviation of the magnetic needle and even of producing certain chemical changes in fluids which are submitted to it. Needles perfectly free from magnetism, were introduced within a spiral of copper wire, containing about one hundred and eighty turns. This cylinder was about one inch and a half long, and one tenth of an inch in diameter: it weighed only four and a half grains, and was contained in a tube of glass of a diameter just sufficient to receive it. The electrical discharges of a vigorous torpedo having traversed the wire for some minutes, the needles were strongly magnetised. The same action having been transmitted across the wires of a multiplicator, produced a decided deviation of the needle; the inferior surface of the electric organ of the torpedo, corresponding as to its effects to the plate of zinc of a voltaic range and the superior surface to the plate of copper.

No effect of ignition was perceived when the discharge was passed through a silver wire of the thousandth of an inch diameter. No well marked spark was obtained when the circuit was interrupted; the slightly luminous appearances which were then observed being

* See Bibl. Univer. 1829, Tome xli. p. 99.

probably of the same kind as those presented by sea water when agitated. A little chain of gold, however, composed of sixty double rings, transmitted the shock; which appeared to prove that air is not impermeable to the electricity of the torpedo. Fine silver wires, interrupted by a solution of common salt, having been placed in the circuit, small bubbles of air appeared around the point communicating with the inferior surface of the torpedo; but none appeared on the opposite point; these silver wires having been replaced by wires of gold, gas was disengaged from both extremities, but in greater quantity and smaller bubbles from the inferior than the superior. With a strong solution of nitrate of silver, the inferior point became black, and only two or three bubbles were collected, while the superior point remained bright, and was surrounded by a great number of bubbles. Similar results, but less distinct, were obtained by the use of a solution of the super-acetate of lead.

The rest of the memoir is devoted to a detailed description of the anatomical structure of the electrical organs of the torpedo, and of the muscles which surround them. The tissue of the columnar parts of these organs appears to be homogeneous, with the exception of some fibres, which are probably nervous fillets, and which are found in these parts. A great quantity of water, which may be dispelled by evaporation, enters into their composition; their spontaneous changes are slower than those of muscles. They are not susceptible of contraction under any of the ordinary stimulants, not even under the shock of a voltaic battery, applied, either to the organ itself, or to any of the nerves which encompass it.

The author concludes from this, that these organs are not muscular, but that their columns are formed of tendinous or nervous fibres, filled with a gelatinous fluid.

The anatomical part is terminated by the description of the origin, course and distribution of the nerves which belong to the electrical organs. The author finds that the gastric nerves are derived from them and hazards the conjecture that the superabundant electricity may, when not required for the defence of the animal, be directed to the stomach to assist digestion. In support of this hypothesis, he cites the example of a torpedo, which, while living, had been frequently excited to give shocks, and in the stomach of which was found, after death, a little fish not at all digested. The secretion of mucus was also, either suppressed, or considerably diminished in this animal. The gills being supplied with branches of the electrical nerves the author thinks there may be some connection between the electrical and the respiratory functions, and that the electricity developed is perhaps employed to decompose water so as to furnish air to the organs, in positions in which the animal cannot obtain that of the atmosphere. The author considers the mucous system of the torpedo as fulfilling important functions in the economy of this animal, in consequence of its connections with electric nerves. Contrary to the assertion of Mr. Hunter, he finds that the electric organs, are slightly furnished with blood vessels. He concludes by some remarks upon the particular characters of the electricity of the torpedo, the different employments to which it appears to be destined, and the varieties which different individuals offer in this respect, according to age, sex and other circumstances.—*Philos. Mag. and Journal of Science, No.* 1. *July*, 1832.

4. *Montyon Prizes.*

Extracted and Translated by O. P. Hubbard.

In Mechanics.—The Academy awarded two medals of gold, of the value of three hundred francs each, one to M. Thilorier, for his new air pump, which operates without the aid of a movable piece, the other to M. Pixii fils, for the ingenious arrangements which he has introduced into electro-magnetic apparatus.

For the discovery of the means of rendering any art or trade less unhealthy.—The Academy awarded nine thousand francs, to M. Ismael Robinet, glass worker, of the glass house of Bacarat, for the invention of an instrument, a proper substitute for the blowing of the lungs in the construction of crystal glass,—giving more power and perfection to the processes of fabrication.

A memoir by Gendrin, upon the use of sulphuric lemonade as a preventive of, and remedy in lead colic,—was presented to the Academy and recommitted to the author for more observations in support of the efficacy of this mode of treatment.

In medicine.—The Academy awarded to M. Dr. Rousseau, for his experiments upon the efficacy of the leaves of the holly in intermittent fevers, fifteen hundred francs. 2. M. Lecanu, for his chemical researches upon blood, the same sum. 3. M. Parent Du Chatêlet, for his eperiments to ascertain at what point, the water-rotting of hemp is injurious to its soundness, an equal sum. 4. M. Manec, for his treatise, theoretical and practical, upon the ligature of the arteries, four thousand francs. 5. M. Bennati, for his physiological researches upon the modification of the voice produced by the organs situated above the larnyx, two thousand francs. 6. M. Deleau, four thousand francs, for a new instrument of his invention, applicable to the diagnosis and to the treatment of diseases of the ear. 7. M. Merat, fifteen hundred francs, for having contributed to make known in France, and encouraged the use of the bark of the pomegranite in tænia. 8. M. Villermé, fifteen hundred francs, for his researchés upon the comparative duration of human life, the development of the human form, and the frequency of diseases, in the two opposite conditions of ease and poverty. 9. M. Leroux de Vitry-le-Francais, two thousand francs for the discovery of salicine and of its febrifuge properties.

Prize in statistics.—This prize, a gold medal valued at five hundred and thirty francs, was decreed to the "Topography of Vignobles" of M. Julien, edition of 1832.

5. *Medals founded by Lalande.*—The Academy, awarded this year, from a legacy by Lalande, two gold medals of three hundred francs,—the one to M. Gambart, director of the observatory of Marseilles for the discovery, on the 19th of July, 1832, of a new comet,—the other to M. Valz, of Nîsmes, for astronomical researches upon the diminution of volume, which the nebulosities of comets experience, as they approach the sun.

Montyon prizes, of a gold medal, of five thousand francs, are offered for each of the two following subjects,—the memoirs to be sent free of postage to the Sec. of the Institute before Jan. 1, 1834.

Question in Medicine.—To determine what are the alterations of organs in those diseases called continued fevers? What relations exist between the symptoms of these diseases and the alterations observed? To insist upon the therapeutic views deducible from these relation?

Question of Medical Chemistry.—To determine the physical and chemical alterations of the solids and liquids, in the diseases denominated continued fevers.—*Ann. de Chim. et de Phys. Nov.* 1832.

6. *Natural Philosophy.*—The Academy proposes a prize of a gold medal of three thousand francs, for a theory of the phenomena of hail, supported by positive experiments and various observations made, if possible, in the very regions of the productions of hail and which may be substituted for the present vague and unsatisfactory observations.

In treating of the formation of hailstones, as to their physical constitution, and the enormous size which they sometimes attain, as to the seasons of the year, and the parts of the day when they are most commonly observed, it will be indispensable to follow out the consequences of the theory adopted, to numerical applications,—whether the theory employs the known properties of heat and electricity—or be founded upon new properties, resulting from incontestable experiments. Memoirs to be sent to the secretary of the Academy, before the 1st of March, 1834.—*Idem.*

7. *Astronomy.*—Observations upon the disappearing and reappearing of the ring of Saturn,—and new elements of the comet of Biela; by M. L.-F. Wartmann.

M. Wartmann made his observations at Geneva, in accordance with the request of M. Bessel of Königsberg, addressed to the observers of all countries, so as to be able to fix precisely the time of the disappearing and reappearing of the ring of Saturn.

"On the 22d April last, at 9 P. M. sky very clear, M. Wartmann observed Saturn with an excellent achromatic telescope, by Dollond, mounted parallactiquement, of three inches and a half aperture, and of forty-two inches focal distance, and of a magnifying power of one hundred and thirty-five times. The ring was hardly perceivable, and appeared like a small straight line in crossing the disc of Saturn, and projecting on each side. On the 23d, at three-quarters past nine P. M. the sky perfectly serene, with the same telescope, M. W. could not see any trace of the lines which, the evening before, fringed the planet, and could perceive, upon the disc of Saturn, about the equator, only the projection of the shadow of the ring like a straight stripe of a deep color.

The sky was partially overcast from the 24th to the 28th of April, and no new observations were made till the 29th, at eight, nine, and ten P. M., when in a still time, and clear sky, Dollond's instrument and also another by Fraunhofer, of four inches aperture, and six feet focus, and magnifying two hundred and forty times, were directed to the planet, without discovering any trace of the ring. The projection of the shadow of the ring upon the disc of Saturn was feebly visible with Dollond's telescope, but very distinctly with Fraunhofer's, especially towards ten o'clock. It appeared like a small grey line, sensibly curved, (convex downwards,) and dividing the disc of Saturn into two unequal parts, the superior much smaller than the lower.

The disc was very fair, well defined, and the flattening strikingly apparent.

The moon was in the tenth day of her phase, within about eight or ten degrees of Saturn; the two bodies were elevated far above the horizon, and situated nearly in the meridian. The ring was last seen at three quarters past nine, P. M. April 22d, and this observation perfectly confirms the prediction of Dionis of Sejour, see p. 17 of his book published in 1776, entitled "Essay upon the phenomena relative to the periodical disappearing of the ring of Saturn." According to the calculations of this astronomer, the first disappearing ought to have occurred on the fourth of October, 1832, and the reappearing on the fifteenth of December following; the second disappearing should happen on the twenty-third of April, 1833, and the reappearing on the twentieth of June following.

MM. Bessel and Struve, found that the first disappearing of the ring would happen at three A. M. on the thirtieth of September, 1832, and the reappearing on the first of December, 1 P. M. the second disappearing on the thirtieth of April, 1833, at 10 P. M. and the reappearing on the ninth of June following at 6 A. M.

The Bureau des Longitudes of Paris has published in the Annuaire for 1832, still different results from either of the preceding.

It is hoped that actual observations, with powerful instruments, will furnish complete data to enable astronomers to announce with precision the future returns of this phenomenon, the first of which will occur in 1848, at the close of the month of April.

Comet of Biela.—It is known, that this telescopic star, whose actual revolution is two thousand four hundred and forty-five days, has pursued, in its return last year, a track a little different from that which it should have traversed according to the Ephemeris of MM. Santini, Damoiseau, Henderson, &c. M. Valz, of Nismes thinks the resistance of an etherial fluid has contributed somewhat to this slight disturbance.

M. Santini, with different elements obtained in his results a remarkable variation, but by collecting all the observations made during the last appearance of the comet, he obtained the following new elements, never before published. The great axis and mean motion are those established by M. Damoiseau.

Passage to the perihelion, 1832, Nov. 26^{d}. 153170, mean time at Padua.

Longitude of perihelion	110° 0′ 55.05″	of the mean equinox
Longitude of node	248° 15′ 36.09″	of Jan. 0, 1833.

Inclination	13° 13′ 0.92″
Logarithm of the eccentricity	9.8759106
Logarithm of half the great axis	0.5486142
Mean siderial, diurnal motion	533.4409″

Bib. Univ. Mars, 1833.

PHYSICS.

8. *New property of elementary electromotors.*—Prof. Dal Negro, in experiments, to discover some useful application of the magnetism communicated to iron by electrical currents, was led to examine into the greatest effect which could be obtained from the smallest quantity of zinc.

By zinc plates of various sizes, commencing with those of an inch surface, and ending with those of one hundred and twenty and one hundred and forty square inches, he magnetised a horse-shoe of iron, wound with a spiral. The effects in each case were noted, and those of the smallest plates examined by the simple galvanometer. From these experiments often repeated, the following results were obtained.

1. Other things being equal, the most useful effect or the greatest relative force was obtained from the smallest plate of zinc. Relying upon the constancy of this important result, he constructs elementary electromotors of plates of zinc, smaller but never larger than one square inch.

2. To obtain from a given plate of zinc the greatest absolute effect, divide it into the greatest possible number of parts, and join them (par le bas) with copper wire, and arrange them parallel, by tens or twenties at pleasure, so as to form a single system, and plunge them all at the same instant, into a small copper trough, subdivided into as many compartments as there are series of plates, and filled with acidulous water.

3. The effect of a given plate of zinc is increased by a simple change in figure, of the same surface but of a larger perimeter; e. g. by reducing a square zinc plate, containing four square inches, to a rectangle of six inches long, and three lines high, the effect is more than doubled.

4. The increase of the electromotive power depends, for a time, upon that of the perimeter, and the division of the constituent parts of the most oxidable metal, or, which amounts to the same thing, it depends upon the sum of simultaneous currents, which take place in

this particular disposition of the metals which compose the elementary electromotor.

The surprising effect of Wollaston's miniature battery as well as those of Children's great battery which were not proportioned to the metallic surface of the battery are explained by these results.—*Idem.*

9. *Magnetic Experiments.*—Mr. Kupffer in a letter to Sir D. Brewster, announces that he has found, that the intensity of magnetic forces, in steel bars, diminishes as much by the action of cold as by that of heat.

To obtain magnetic cylinders, of constant power, to measure the intensity of the magnetism of the earth, he not only plunges them many times into boiling water, but cools them as often to 20° or 25°, below zero, of Reaumur.

Mr. K. has proved by a direct method, the existence of a daily variation in the dip of the magnetic needle, and in the intensity of the earth's magnetism—the latter, by observing, each day, the extent and duration of the oscillations of a needle of a large dip and suspended upon the edge of a knife.

He found that the dip was greater by some minutes at eleven A. M. than at eleven P. M. and that the intensity of the earth's magnetism is much greater at night than in the morning.—*Phil. Mag. March,* 1832.

10. *Phenomenon presented by the breaking of a Prince Rupert's drop.*—M. Bellani has observed that in breaking the tip of a Prince Rupert's drop, under the water contained in a glass receiver, the latter is broken with an explosion, at the very moment and even when the surface of the water is uncovered. He attributed this effect to the rapidity with which the drop is broken and to the consequent expansion, so great that the water has not time to yield, but communicates, like a solid body, the motion to the sides of the receiver.

This phenomenon is similar to that which occurs when a ball is discharged from a pistol upon the surface of water—the ball is compressed and flattened as it would be if fired against a solid body.—*Bib. Univ. Feb.* 1833.

PHYSICAL GEOGRAPHY.

11. *Spouting fountain of mineral water, discovered in* 1832, *near Cape Uncino, kingdom of Naples, by M. J. Auldjo.*—Bubbles of of air were long since observed to rise trom the bottom of the water

about sixty-six feet and two-thirds from the shore, and Col. Robinson, attracted by this curious phenomenon, commenced boring an artesian well in this place, at the base of a tufaceous rock, the beds of which form the neighboring shore.

Having bored eight feet in a bed of sandy clay, (argile sablonneuse) and eight feet and one-third in a bed of pebbles, a column of water, four inches and a half in diameter spouted up in a very abundant jet. Three other wells were sunk and reached the water—the fourth was twenty-four feet nearer the Cape and the water spouted out from the depth of about fourteen feet.

In this place the strata was first sandy clay mixed with stones (pierres) eight feet, and the other, small pebbles mixed with volcanic ashes, 6 feet.

The water of the first three wells ran upon a very hard bed of lava —that of the last, upon a bed of clay divided into small rounded pieces, mixed with water, now fragments of lava, and volcanic ashes, which is supposed to be the natural bed of the current. The water is tepid, limpid, of an agreeable taste, being supersaturated with carbonic acid; it possesses very decided medicinal properties, and has effected many undoubted cures, among the numorous visitors of the past year. Professor Ricci analyzed sixteen livres, (seventeen pounds and a quarter,) and obtained the following results.

	Grains.
Carbonic acid gas - -	56.5800
Bicarbonate of soda - -	142.5000
" of potassa -	23.0000
" of magnesia -	80.0000
Carbonate of lime - -	43.7500
" of iron - -	0.9062
Sulphate of soda - -	62.0000
" of potassa - -	15.0000
" of magnesia - -	5.0000
Chloride of sodium - -	84.0000
" of potassium - -	31.0000
Hydrochlorate of magnesia -	45.1301
Phosphate of lime - -	2.0000
" of silica - -	9.0000
Peroxide of iron - -	1.6551
" of titanium?	
	599.5214

Nearly 0.41 per cent. of the whole weight.

The jet of water, which at first was raised fourteen feet and two-thirds, has gradually subsided to eight feet. Its force is now so great that it brings up with it not only small pebbles, but fragments of lava, and tufa, one of the pieces of lava weighed two livres. In blasting the tufa for the establishment of baths, and other accommodations, the trunk of a cypress was discovered, still standing, charred upon the outside, but the interior was perfectly preserved. Its circumference was five feet and one third and height three feet and one third. It stood in a thin bed of vegetable earth, covered by different beds of volcanic tufa, was twenty feet and two thirds below the level of the sea, twenty-six feet and two-thirds below the surface of the ground, and five feet and one third below the formed upper surface of the tufa.

This cypress, from its diameter, must have been at least an hundred years old at the time it was enclosed in the surrounding mass, which, in its nature and stratification, so much resembles that which covers Herculaneum, that it may with reason be supposed to be of the same epoch, or rather to be a part of the products of the eruption, which entombed the country south of the foot of Vesuvius, in a shower of volcanic substances. In the same bed with the cypress were found great numbers of snails (helix nemorata and h. decollata;) also fragments of tiles and of pottery, undoubtedly of Roman origin, and like those found at Pompeii and Herculaneum.

It is remarkable, that the outer part of the cypress is carbonized and the interior is uninjured, while at Pompeii and Herculaneum, even the large timbers are charred through the whole mass.

This is probably owing to the cypress being in full vegetation when it was enveloped, and thus it is able to resist the heat of the lava, which is sufficient to carbonize only dead wood.—*Bib. Univ. Mars*, 1833.

12. *Descent in diving bells.*—The Rev. Mr. Alden's account of descents in a diving bell, (Am. Journal for July, 1832,) is translated into the Bibliotheque Universelle, and the translator, in a note, attributes the cure of Mr. Clifford's rheumatism to the great heat produced in the bell, and which is like a (steam?) vapor bath, and says that his twelve descents were almost equal to taking as many warm baths in the waters of Aix or Barrège. The translator once descended twenty five feet at Bordeaux, in a bell, with four other persons, and the heat of their lamp, with that of respiration and that evolved by compression of the air, raised the thermometer, in three quarters of an hour, from 15° to 32° R.

13. *The Georgics.*—The Royal Academy of Sciences, Belles Lettres and Arts of Lyons, offer a gold medal of six hundred francs, founded by M. Bonafous, to be decreed to the author who shall present "a good translation of the Georgics, made or selected by himself, and enriched with better notes and commentaries, better digested, upon (la science agronomique) the theory of agriculture, so as to furnish to young men studying the Latin language the means of acquiring correct notions upon this science, so useful and yet so much neglected in education."

The works should be received by April 1st, 1834, and should be sent, free of postage, with some mark at their head, which is repeated in a sealed note, containing also their names, quality and residence, to M. Dumas, perpetual secretary, to the adjunct secretaries, or to any member of the Academy.

14. *Epidemics in Paris.*—M. Villermé, upon epidemics, considering those years as epidemical, for a city of the size of Paris, when the mortality exceeds by a sixteenth that of the year previous or succeeding, gives the following table for Paris.

For thirteen years of the 17th century,	6 epidemic years.
From 1709 to 1720, (twelve years,)	5
1721 " 1730, - -	4
1731 " 1740, - -	5
1741 " 1750, - -	4
1751 " 1760, - -	4
1761 " 1770, - -	4
1771 " 1780, - -	4
1781 " 1790, - -	4
1791 " 1800, - -	5
1801 " 1810, - -	3
1811 " 1820, - -	3
1821 " 1830, - -	2

Bib. Univ. Jan. 1833.

15. *Permanence of letters written upon a metallic surface after its fusion.*—M. Bellani has made the following curious experiment. Melt, in a small crucible, an alloy of lead and tin, and withdraw the metallic cone, after cooling. On writing, with common ink, upon the metallic surface, which was in contact with the side of the crucible, and remelting the ingot and cooling it again, the very same

letters which were written before the second fusion will be found entire. The experiment may be repeated many times, and the metal may even be shaken while in fusion, and the characters traced upon the metallic surface will always be found again. The phenomenon seems to be caused by the circumstance, that this surface is formed of a very thin coating of oxide, like a pellicle, which does not become fluid with the metal.—*Bib. Univ. Feb.* 1833.

METEOROLOGY.

16. *Use of the Barometer at sea.*—Mr. Clarence Dalrymple, captain of one of the East India Company's ships, in his "Historical Account and Description of British India," (Edinburgh, 1832,) mentions the use of the marine barometer as one reason of the present short voyages between England and India. A vessel may now make a voyage out and home in eight months, which fifty years ago required twelve months. Formerly, to avoid injury from squalls at night, the sails were all *single* and *even double reefed*, at sunset.

Now by the use of this instrument, the observer, who follows its motions, may carry as much sail at night as by day, regarding also a principle of navigation, i. e. to brail up the sails in time before a squall, but to be prompt to spread all sail as soon as the chief violence of the storm is past.

Capt. D., in speaking of the navigation near the Cape of Good Hope, says, "in no part of the world are the indications of this precious instrument more faithful than in the regions of the Cape.

"A rapid descent of the mercury indicates, with certainty, gales of wind from the north west, and often even in a perfectly still time.

"Such a warning ought never to be disregarded. In the southern hemisphere, the mercury rises with south winds and falls with north winds. During light breezes from the south east, after a storm, it generally ranges high, and a considerable descent takes place when the wind shifts to the north east, though there should be no gale.

"This depression is owing to a change of temperature, the north winds being warmer than those from the south, which come from the icy regions of the south pole. If the mercury continue to fall after a southern breeze is established, a more powerful wind may, with certainty, be expected.

"During the most powerful storm the author ever experienced near the Cape, the barometer descended to 28.98 English inches."—*Bib. Univ. Feb.* 1833.

MINERALOGY.

17. *Marine shells in the coal formation.*—Heretofore the coal formation has afforded only vegetable fossils and a small number of shells, which, from their similarity in form to the genus Unio, have been regarded as shells of fresh water. Recently, Mr. John Phillips, author of a valuable geological description of Yorkshire, has discovered a series of carboniferous strata, situated in the lower part of the formation, directly above a coarse conglomerate, called millstone grit. The roof of one bed of coal in this series is full, not of vegetable fossils, as usual, but of a considerable variety of marine shells of the genera Pecten, Ammonites, Orthocera and Ostrea. Among the species, Mr. P. has discovered the *Pecten papyraceus* and the *Ammonites Listeri.* It is remarkable, that this last species, hitherto regarded as peculiar to transition formations, has the peculiar characteristics of the Ammonites of this epoch, i. e. the absence of notchings (dentelures) upon its lobes. In the coal mine of Swan Banks, near Halifax, there is a bed of fresh water shells (Unio) below the marine bed, and between it and the millstone grit. It seems to result from this important observation, that the waters of the sea, in which the transition limestones were deposited, after having given, for some time, free scope to the fresh water, where the coal beds were formed, have again re-covered, in a moment, the regions which the fresh water invaded more slowly, and where it accumulated those thick deposits of coal now explored in this part of England.—*Lond. and Ed. Phil. Mag. Nov.* 1832, *p.* 349.

18. *Notices of some of the volcanos and volcanic phenomena of Hawaii, (Owyhee,) and other islands in that group, in a letter from Mr. Joseph Goodrich, missionary, dated Nov.* 17, 1832.

[The specimens named in this letter, have arrived in good order.]

TO PROFESSOR SILLIMAN.

Dear Sir—Since I wrote last, I have been up Mauna Kea, and also nearly around it; in the valley between Mauna Kea and Mauna Loa, the path lies along so near the former, that the snowy summit is not to be seen till the traveller has nearly reached the opposite side; while Mauna Loa presents an appalling aspect, streams of black, dismal looking lava having run from the top to the shore, so very ragged and uneven, that it is almost enough to tear or cut one's hands and feet to pieces to cross over them. A person who has never seen any thing of the kind, cannot form any adequate idea of the extreme roughness of those currents of lava; and even those who have seen them, and who have not seen the process of formation, (of which I have happened to be an eye witness, and am to describe it hereafter,) cannot imagine how it was ever formed into such rude, rough, ragged and broken masses.

In ascending Mauna Kea, nothing occurred very materially different from what I have heretofore mentioned; a severe head ache, affecting the natives as well as myself, with sickness at the stomach and vomiting of bilious matter, usually attends me in those lofty regions.

The minerals that I brought down consist, as you will perceive, of fragments of granite rock, imbedded in lava. There is one specimen, wrapped in white kapa, with black figures, and all the specimens from the summit of the mountain are wrapped in the same kind of kapa. The specimens of compact lava, (much resembling hornstone,) are the material of the native adze, such as they were accustomed to use before they were acquainted with iron; those which I send, are now in their rude state, as taken from the quarry, in a cave near the summit, where they were roughed out and afterwards taken down among the inhabitants for sale. No persons ever lived within twenty or thirty miles of the place where they were roughed out.

I saw some specimens of granite a foot or more in diameter; the cohesion was, in general, quite feeble, doubtless the effect of volcanic fire, of which there are evident marks on almost every rock on the island.

In my last journey up the mountain, I found the pond or lake of water, of which I had frequently been informed. It is situated just at the foot of some of the highest peaks of the mountain, on the south east side, probably not far from a thousand feet from the top. The lake is seventy five rods in circumference, or twenty five in diameter; it was about one half frozen over, when I visited it in December; the ice was sufficiently firm to bear sliding upon; the natives, however, were not much inclined to make the trial, for being barefoot and half clothed, they were indisposed to move unless we were on our way downward. The water appeared to be very deep, and none was discharged from it when I was there; although there appears to be an outlet when the snow melts. There not being much snow at the time of my visit, I could not discover that the lake is fed by springs, or even snow, for the rocks, cinders and scoria, were all dry about it.

Strawberries, whortleberries, and raspberries, black and yellow, grow, in abundance, upon the sides of the mountain, until you pass the line of vegetation; below this region, is a dense woody belt, nearly surrounding the mountain; it is from five to twenty miles through, and below this, until reaching the shore, a distance of six or eight miles, is the region for cultivation.

In the box which I have put up for you, to be sent by the present opportunity, is one cocoanut shell, filled with sand from the beach, at the bay. When it is melted in an iron vessel, in a blacksmith's forge, it makes black, porous lava, not very dissimilar from other specimens in the box.

About fourteen months since, I was requested by my brethren, to leave my station, for a season, and to remove to Oahu, to superintend the printing press, and instruct in book-binding some of the natives, who were quite disposed to learn. While there, in January last, about the 12th, (as near as I can ascertain,) the volcano commenced a vigorous system of operations, sending out volumes of smoke, and the fire underneath, so powerfully illuminated the smoke, that it had the appearance of a city, enveloped in one general conflagration. A day or two following, smart shocks of earthquakes commenced, to the number of six or eight in the course of the day; they shook the house so violently, that those who occupied left it and took up their lodgings, for two or three days, in a native house, when the shocks ceased and have not been since felt.

On the 20th of June, volcanic eruptions broke out upon the top of Mauna Loa, (which is about the same height as Mauna Kea,*) and the mountain continued burning for two or three weeks; the lava was also seen running out of the sides of the mountain, in different places; it discharged the red hot lava from so many vents, that it was seen on every side of the mountain; it was visible as far as Lahaina, upwards of one hundred miles. As that mountain, as far as I can learn, has never been ascended by any person, I contemplate attempting the ascent, while making a tour of the island in January next. Should I succeed, and discover any thing worth notice, you may expect to hear from me by the next opportunity.

I returned home to this place in July last, and embraced the first favorable opportunity to go up to our volcano of Kirauea and see what alterations had taken place since I saw it last. About the first

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* 18,000 feet.

of September, I made a short visit to the volcano, and found that there had been a tremendous action in and about the crater; the crater had been filled up to the black ledge and about fifty feet above, about nine hundred feet in the whole, since I first visited it, and it had now again sunk down to nearly the same depth as at first, leaving, as usual, a boiling caldron at the south end. The inside of the crater was entirely changed; the earthquake in January last had rent in twain the walls of the crater on the east side, from the top to the bottom, producing seams from a few inches to several yards in width, from which the region around was deluged with lava. The chasms commenced at the bottom of the crater, rending every thing in their way, and took an easterly direction up the perpendicular walls of the immense caldron, within a few yards of where Mr. Stewart, Lord Byron, myself and others have slept, when visiting that awful place; so that the very spot where I have lain quietly many times, is entirely overrun with lava; almost all the specimens in the brown kapa were taken from the place where I have slept, as also Lord Byron and others.

Huge rocks were thrown in various directions; the chasms continued eastward, rending the causeway that connects the two craters, the mass of which, with the region around, has sunk about a foot, as is evident from the walls farther back. The path in front of the lodging place, by which we descend into the abyss, is now rendered entirely impassable, by the rending of the rocks and deluging of the lava, so that another path, that is more difficult, is the only one remaining. I found it a much more arduous task to descend to the bottom than formerly; after travelling from the north to the south end, I found myself on the brink of a burning lake or glade, if the word will apply to this scene. Here was an opening in the lava, about twenty feet below, sixty or eighty rods long, and twenty or thirty rods wide; the whole mass of liquid and semi-fluid lava was boiling, foaming and dashing its fiery billows against the rocky shore; the mass was in motion, running from north to south, at the rate of two or three miles an hour, boiling up as a spring at one end and running to the other.

Mr. Stewart's description of the bottom of the crater, as contained in his journal of his residence on the island, page 381, gives a fair account of the bottom of the crater, as it at present appears, with the exception of the lake or glade. Imagine to yourself, a river congealing with the cold in the winter season, the current floating the ice along down, and crashing against the shore and against itself, in every direction, and you will have some idea of its appearance, except that here is heat and there is cold. The lava on top being stiffened with cold, was dashed against the shore, and was tumbled and distorted into every form and shape as it came in contact with the shore; it would melt away, while more was continually forming upon the surface, and while the gaseous matter was forced through, scattering the liquid fire in every direction. The scene was terrific and appalling; I know not that it is possible to give any adequate conception of it, unless actually beheld by one's own eyes.

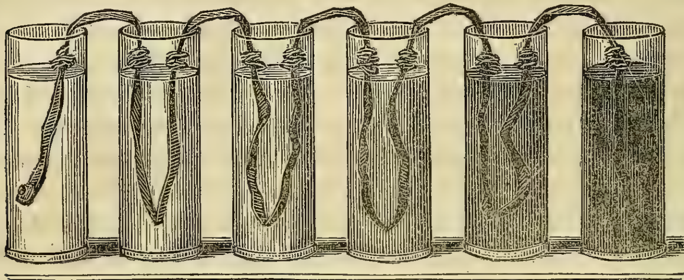
The specimens in the white kapa were taken from the brink of the lake or glade, perhaps thrown out a few days, and possibly but a few hours before, as they and the rest of the lava were so hot as to be quite uncomfortable to the hand. There were two islands in the lake; on what they were based, it would seem difficult to say. It was here I saw how the lava becomes so rough and distorted; I saw how it was thrown and dashed about, by the gaseous matter and the fiery currents. I ought to have mentioned before, that the chasm extended from the top to the bottom, and that back of it at right angles with the main chasm, about half way up the precipice, there was a vent a quarter of a mile in length, from which immense quantities of lava boiled out directly underneath the hut formerly occupied by the party of Lord Byron.

In one of the cocoanut shells is some capillary volcanic glass collected from the south-west side, before I descended into the crater. It is so extremely light that I found it only in holes and crevices, in which places it was collected by the wind. Upwards of a year ago, a shock of an earthquake was felt here by myself and others. At the same time a commotion at sea was perceived by three of the natives, about four or five miles from shore, in front of the bay; the water rose in the form of a cone or pyramid much higher than the bread fruit trees, that are sixty or seventy feet high; in appearance it was white like the spray of the sea.

19. *On the tendency of Iron to preserve copper exposed to sea-water.—Extract of a letter to the Editor.*—It is generally conceded among shipmasters and merchants, that the copper on ships' bottoms, does not last half so long now as it used to do many years back; various reasons have been given for it but none have appeared satisfactory. The Cornwall miners work the ore now as their fathers did, and no

more or other alloy can enter into it now than did a hundred years ago. The London copper is by some preferred to the Liverpool, and many think the American is better than any other ; but there is no great difference, all wear out in a surprisingly short space of time.

In former times our vessels were all *iron* fastened, now they are fastened with *copper ;* because it has been found that the copper destroys the iron, but may it not be that the same galvanic action *preserved the copper ?*



I saw lately in the Philosophical Hall at Rotterdam a simple experment, which, in my opinion, went far to illustrate this theory. A long strip of copper was bent snakelike (as in the annexed figure,) into five or six loops or bights each of which was immersed in a separate vase of sea-water,—a small piece of iron was riveted to the end of the copper in the first vase,—after remaining there five or six months, the water in the first vase was slighily tinged with red, that in the second had a shade of blue scarcely perceptible, in the third it was green, in the fourth a very dark olive, and in the last it was almost black. At the top of the water in each glass there was a bit of cotton-wick, wound loosely round the copper, to give, as I imagined, more surface for the action of the air and water, and there the corrosion was the greatest, and in proportion to its distance from the iron.

As I am rather out of the way of chemical researches, it is possible that this idea may be trite to you, but if you should find it worth your while to try the experiment and follow it to some higher result, it might lead to some improvements in the manner of sheathing ships which would be of essential interest to our merchants.

A. Scott.

Remarks by the Editor.—There can be no doubt that the suggestions of Capt. Scott, as to the cause of the protection of the copper, in the experiment which he saw at Rotterdam, are correct. The iron was corroded, and this preserved the copper; most effectually in the vessel where both metals were in contact, and the copper was corroded, more and more, as it receded from that point. Sir H. Davy's galvanic protection of the copper sheathing on ships, is well known, and its failure arose, from a very unusual cause, namely, its perfection: the marine shell fish, being no longer, as before, poisoned by the solution of the corroded copper, collected in enormous quantities, during long voyages, and thus retarded the sailing of the ship. Perhaps the experiment has been too hastily abandoned, and had its illustrious author lived, in his accustomed vigor and zeal, he might, not improbably, have modified his protection by zinc or iron, to that degree which might have afforded both a poison for the sea insects, and adequate protection for the copper. The public are acquainted also with the ingenious experiments of Dr. John Reverè, on the same subject; they appeared very nigh to entire success, but we are not aware that any trials of the kind are now making on a large scale. Capt. Scott's suggestion as to the cause of the protection afforded by the iron pins to the copper sheathing is undoubtedly correct, and although it might not be expedient to resume the iron pins, it might be entirely judicious to attach a very small portion of iron or zinc to every sheet of sheathing on a ship's bottom.

Capt. Scott, being about to sail again for Holland, kindly proffered his services, which were gratefully accepted, for the purpose of bringing home any interesting notices that might fall in his way respecting foreign science and arts.

After remarking, that "a high scholar once told him that if shipmasters would sometimes make use of their eyes and ears, abroad, they might add much to the stock of science at home," he adds, that he saw at Rotterdam a galvanic magnet, of six or seven pounds power. This was doubtless of the same general construction as that of Professor Joseph Henry, described two years ago in this Journal. It will be remembered that the latter lifted more than two thousand pounds and with some additions that have since been made, it would now lift probably several hundred pounds more.

20. *Prize offered by the Imperial Academy of Sciences, of St. Petersburg, at its public sitting December 22d*, 1832, *and January* 10*th*, 1833.—Communicated by John Vaughan, Esqr. of Philadelphia.

The experiments of Gay-Lussac and Thenard upon the manner in which potassium acts in ammoniacal gas, have brought to light a particular kind of compound, to which they gave the name of *ammoniacal azoturet of potassium;* although this name expresses a particular mode of combination, still, the experiments of the French chemists do not determine, with sufficient exactness, the elementary composition of this substance, especially, as these experiments, when repeated by Davy, furnished different results.

New experiments, conducted with all the precision belonging to the present state of the science, are demanded, in relation to the ammoniacal azoturet of potassium. These experiments should be prefaced by an exposé of those of Gay-Lussac and Thenard and of Davy. References should also be had to what is stated on this subject in the second volume of the French edition of Berzelius's Chemistry.

The authors of the memoir, after having determined with precision, the elementary composition of the subject of his experiment, will try to elucidate the mode of combination which appears most probable to express the nature of the substance analyzed.

The pieces should be sealed and they may be written in Russian, German, French or Latin, and addressed to the perpetual secretary of the Academy, before the first of August, 1834. The prize of one hundred Dutch Ducats, will be decreed in the public sitting, to be held on the 29th of December of the same year. The successful piece will be printed at the expense of the Academy.

21. *Dr. Young's Elements of Geometry, &c. &c.*—"The Elements of Geometry,"—"The Elements of the Differential Calculus," —and "The Elements of the Integral Calculus," by Dr. Young, have been presented to the public by Carey, Lea and Blanchard, in three octavo volumes. They are designed for the use of Colleges and Universities, and contain full elementary expositions of the subjects of which they treat.

It is the author's plan to give a larger and more comprehensive view of Geometry, than has been done by any preceding geometer; and it is his aim to adhere to that accuracy of reasoning, and rigor of proof, in his geometrical investigations, which shall not leave conclusions "only approximately true," but shall establish every proposition by demonstrating the *converse* where demonstration is possible, pointing out "those cases where it necessarily fails." This mode of proceeding must be highly satisfactory to the learner, who thus not only ascertains, that "under certain conditions a certain property must have place, but also, whether it is possible for the same property to exist under any change of those conditions."

While the author designs to establish the doctrine of geometrical proportions with the rigor of proof peculiar to Euclid, he has endeavored to relieve the subject from the intricacy and subtlety of the elaborate reasonings of that great geometer, which opposed very serious obstacles in the way of the student.

The Editor has interspersed some important propositions, for which he acknowledges himself indebted to Legendre, and Leslie, and to Bland's geometrical problems, and he has also added some methods on the rectification of the circle.

Although the eminence of the French philosophers is generally acknowledged in most branches of abstract science, yet they have not succeeded in demonstrating the quadrature of the circle. Dr. Young, in common with many others, deems it incapable of being rigorously ascertained;" although by inscribing and circumscribing polygons, on Gregory's method, (which Dr. Young employs,) within and without a circle, a coincidence with it may be so nearly ascertained that for all practical purposes, it is equivalent to perfect accuracy. The seventh Book is devoted to the properties of polygons, and in the tenth proposition it is shown "that the arcs which the sides of a polygon subtend are bisected. The chords of the half arcs will be the sides of a regular polygon having double the number of sides." And in the scholium to the thirteenth proposition he says, that "Having obtained numerical expressions for polygons of eight sides, by an application of the same two proportions in a similar way, the surfaces of sixteen sides may be determined, and thence of thirty-two sides, and so on, till we arrive at an inscribed and circumscribed polygon differing from the circle, and from each other so little, as to be unassignable by any *numerical* expression. The inscribed and circumscribed polygons of 32,768 sides, differ so little from each other that the *numerical* value of each, as far as seven places of decimals is the same, and as the circle is between the two, it cannot differ so much from either as they do from each other.

"The number 3.1415926 expresses correctly the area of a circle, whose radius is one, as far as seven places of decimals," and if it were necessary, the approximation might be continued to an almost endless extent. "An infinite series was discovered by Machin, by which he reached the quadrature as far as the hundredth place of decimals, and even this number has been extended thirty or forty figures farther by later mathematicians."

"For the ordinary purposes of mensuration, the circumference will be determined with sufficient precision by multiplying the diameter by twenty-two and dividing the product by seven, which is the approximation discovered by Archimedes."*

To the popular reader it may be interesting to know that the Differential and Integral Calculus, teach the analytical methods of proceeding in the pure mathematics, analogous to Algebra, the calculations are divided into *constant* and *variable* quantities, in place of the *known* and *unknown* quantities of Algebra. The differential calculus determines the effect produced by a given cause; the integral shows how to determine the cause which produced a known effect." The calculations proceed by methods and expressions similar to the algebraical notations and processes.

It is the author's aim to furnish the scholar with a complete view of modern analytical science, and to free this higher order of mathematical research from the contradictory theories, and exceptionable principles, which have pervaded every preceding book on the Calculus, harassing and obstructing the progress of the student, and discouraging him with inconsistencies.

It is believed that the author has succeeded in perfecting "this most powerful instrument which the modern analysis places in the hands of the mathematician," and the student may be cheered by the guide thus afforded him, amidst the difficulties of a laborious but sublime and elevating career of enquiry.

New York, August, 1833.

22. *On the Cashmere-Angora Shawl Goat.*

TO PROFESSOR SILLIMAN.

Dear Sir—Many attempts have been made in Europe, to domesticate the Cashmere goat, "the down" of that animal being the material from which are fabricated the most beautiful and costly shawls that are brought from the East. This down is considered the most precious and "the most beautiful filaceous material known," combining the fineness and softness of down, and the warmth of wool, with the lustre of silk.

The following facts are derived principally from the Transactions of the (British) "Society for the Encouragement of Arts, Manufactures, and Commerce," for 1831–32.

* See p. 140 Elem. Geom.

The first race of Cashmere goats, imported from Persia to France, under the patronage of the government, promised little profit to the owners. They were healthy, and tolerably hardy, but of various sizes and colors; and the soft fleece, which alone was valuable, was very small in quantity, and overgrown, and almost concealed by long hairs. After a few years, however, a very superior herd was raised at Versailles, by M. Polanceau, the director of the "*ferme modèle*, at Grignon," possessing the best qualities of the original Cashmere, with those of the soft, long, silky-haired, native Angora. M. Polanceau states, that some of his improved breed yield "thirty ounces of down in one season," and the whole herd produce from twelve to twenty ounces each; while the original Cashmere never yields more than four, and seldom exceeds two ounces.

The animals are "less capricious than the common goat, may more easily be kept in a flock, and are more docile even than sheep."

The down falls in a manner similar to the wool from sheep, in the month of March, and may be taken off in locks by separating it gently with the hand from the skin. It is best, however, when sheared off in one fleece as soon as it begins to loosen; for the parallelism of the filaments is thus better preserved, and it is more readily combed and prepared for manufacturing purposes.

They are not, as has been apprehended, difficult to keep, but are allowed to remain all winter in open sheds. Like all other browsing animals, "they prefer the leaves of trees, but thrive well on hay, straw, green fodder, or in meadows. They also feed with equal facility on heaths, and on the most abrupt declivities, where sheep would perish."

M. Polanceau, at first, gave them aromatic herbs, occasionally, for a year or two, but of late has discontinued the use of them, without any injurious effect. The down commences growing in September, and in March arrives at full maturity, when it falls off, unless removed artificially.

The Society awarded to William Riley, Esq. their gold Isis medal, for his importation from France of a select number of these valuable animals, with the view of introducing them into the colony of New South Wales, and Van Diemen's Land; where the wools of the merino and Saxony sheep have so far improved, as to be preferred, by intelligent manufacturers, to those brought from any part of Europe.

The southern part of New South Wales, and Van Diemen's Land, are in corresponding *south* latitudes with Cashmere in Thibet and

Angora in Asia Minor in the *north;* while Versailles, where this herd is so flourishing, producing more down than even in their native districts, is 12° or 14° farther north than Thibet, and 8° farther north than Angora, which is in N. lat. 40°, 200 miles E. S. E. of Constantinople.*

From reviewing all these localities, we may presume that our own country, within its boundless varieties of climate and vegetable productions, may yield such favored spots, as will enable the enterprising agriculturist to domesticate this valuable animal, as well as the choice varieties of foreign sheep; and with much greater probabilities of success, than attended the first attempts at the culture of silk, which was, for ages, believed to be a particular gift of Heaven to China, from whence it was not deemed possible to extend it, to any other region of the globe.

M. Polonceau, who has the choicest herd in Europe, perhaps the only one of Cashmere-Angora, disposed of four to the King of Wirtemberg, in 1828, for the small sum of three thousand four hundred francs; and in 1831 parted with thirteen more to Mr. Riley, as above stated. This race of animals have not in the least degenerated, since they first came into M. Polanceau's possession, ten years ago, but their peculiar properties become annually more and more fixed. The superior quality and quantity of their fleeces, with the precious nature of the material, offer strong inducements to the agricultural capitalist of some of our mild hill countries, to obtain some of them by way of trial.

The herds of M. Polonceau are probably, by this time, so numerous as to enable him to sell a sufficient number for an experiment, which, if successful, would secure a profit to the proprietor, and accomplish an important national object. The peculiarities of climate and the vegetable productions of Angora, with the habits of the goat on its native soil, might be ascertained beyond doubt, by application to our countryman, Commodore Porter, who is investigating a variety of subjects, in that part of Asia which is most interesting to science, manufactures, and commerce.

With great respect, I am, &c.

New York, August, 1833.

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* Port Jackson, in New South Wales, is in S. lat. 32°. Van Diemen's Land is in S. lat. 40°.

23. *Meteorological Journal.*—Abstract of Meteorological observations, taken at Savannah, Geo., by Wm. H. Williams, from June 1, 1832, to June 1, 1833, lat. 32° 8′ north; lon. 4° 8′ west of Washington city.

MONTHS.	Thermometer.			Warmest day.	Coldest day.	Atmosphere.				Prevailing winds, stated in days.				Prevailing wind for the month.
	Mean temp.	Maximum.	Minimum.			Fair days.	Cloudy days.	Rainy days.	Variable days.	N. & N.W	E. & N.E.	W. & S.W.	E. & S. E.	
June, 1832.	81	92	73	16	21	20	6	4	0	4	13	10	3	N. W. & W.
July, "	84	94	74	21	14	18	4	9	0	5	11	8	7	N. E. & E.
August, "	82	90	77	11	29	2	4	25	0	4	11	6	10	N. E. & E.
Sept. "	77	90	66	5	14	13	5	12	0	6	9	9	6	S. & E.
Oct. "	71	84	52	12	25	12	13	6	0	7	15	4	5	N. E. & E.
Nov. "	64	87	44	6	24	12	12	6	0	14	5	8	3	N. W. & W.
Dec. "	54	72	30	27	22	7	14	10	0	12	6	5	8	N. W. & W.
Jan. 1833.	56	72	20	2	11	6	11	6	8	8	6	10	7	S. W. & S.
Feb. "	59	78	38	19	8	14	8	0	6	5	9	7	7	N. E. & E.
March, "	62	80	40	1	2	11	18	0	2	6	7	6	12	S. E. & E.
April, "	69	83	57	25	1	10	10	3	7	8	9	7	6	N. N. W.
May, "	79	89	65	29	2	12	16	0	3	2	11	7	11	S. & E.
	69°.83					137	121	81	26	81	112	87	85	

Mean temperature of the thermometer for the year,			69°.83
" average " "	summer months,		82
" " " "	autumn	"	71
" " " "	winter	"	56
" " " "	spring	"	70

The greatest quantity of rain fell in August, 1832, and in April, 1833. There was more rain in April, 1833, than in the winter months. July 1832 was the warmest month. Average of thermometer, 84°. Dec. 1832 was the coldest month. Average of thermometer, 54°. July 21, 1832, the warmest day; thermometer 95°. January 11, 1833, the coldest day; thermometer 20°. The month of August, 1832, the mean average of the thermometer, varied from 80°, the lowest point at any time, to 85° the highest. This month was very wet, and very healthy; wind easterly. Distinguished health, was enjoyed during the year in this city; no prevailing epidemic of any description. The first frost was on the evening of the 24th of October. Vegetation was in verdure at the close of November. On the morning of the 10th of January, there was a little flurry of snow.

Chatham Academy, Savannah, Geo. June 29, 1833.

24. *Transactions of the Literary and Historical Society of Quebec.*—The second volume of this society, published in 1831, em-

braces a variety of interesting and valuable communications, relative to the Natural History, Topography, and Geography of the Canadas; and in particular, a paper, entitled, "A Grammar of the *Huron Language*," which occupies above one hundred pages of the Transactions. Parts I. and II. of Vol. III. for July, 1832, contain a Memoir on the Mirages of the St. Lawrence, one on the Climate of Canada, a mathematical paper on parallel lines, and a communication on the plants of Canada. Part II. contains the continuation of Mr. Sheppard's Notes on the Plants of Lower Canada, Lt. Baddeley's Report on the Magdalen Islands, with a handsome lithographic map, and a notice on the pigments of Canada. This society cannot fail of receiving the high commendations which it deserves, for the spirit and success with which it has thus far been conducted.

25. *Exchanges in Natural History.*—M. T. D. Michahelle, Dr. Med. and Phil., Munich, in Bavaria, in a letter to the Editor, dated April 24, 1833, proposes to the naturalists of this country, to exchange the animals and plants of Southern and Central Europe, (particularly those from the Alps of Germany and Switzerland, Italy, France, Dalmatia, and Albania, and their confines,) for those of North America.

Dr. M. is very desirous of these exchanges, and wishes to obtain of the class mammalia, aves and amphibia, one, two, three, four, or more specimens of each species; of the mollusca, only those species which inhabit the land or fresh water; of insects, only the coleoptera and lepidoptera; of plants, all, both phanerogamous and cryptogamous. He will furnish to those who desire it a complete catalogue of each class and order of his collection.

26. *Magnetic Oxide of Iron.*—Copy of a letter from Thos. G. Clemson, to Hez. B. Pierpont, Esq., dated Paris, May 23d, 1833.

Sir,—Some two months since, Mr. Henry Evelyn Pierpont put into my hands a specimen of a magnetic oxide of iron, having a crystallized structure, color grayish black, and when reduced to powder, of a greenish brown. It acts upon the needle, without possessing evident marks of polarity. It was from Franklin County, State of New York.

As he desired, I examined the same, and the following are the results, which he desired that I should forward to your address.

The substance, when heated with muriatic acid, leaves no insoluble residuum. 20 grammes of the ore, and 6 grammes of borax, were submitted together in a brasqued crucible, to an ordinary assay heat: the result was, iron and scoria 15·42; iron alone, 12·90.

Then 100 parts of the ore contain 64·50 of metal, which appeared to have all the properties of steel.

27. *A Parasite of the Honey Bee,** [*Apis mellifica.*]—For a few years past, many of those people, in this vicinity, who have apiaries, have found that in the month of April, May and June, an unusual mortality has prevailed among their bees. This circumstance has led to a thorough investigation of the cause, by those, who have felt a particular interest, in the products of this valuable insect; and the result has proved, that this mortality has been produced entirely by a parasite.

More than two years since, one of my neighbors, suggested to me his conjectures, that there was a parasite fly, that was injurious to the honey bee; since which time, we have fully ascertained the fact. I have, a box, now before me, containing a great number of dead bees in which may be found the parasites, in both the pupa and the perfect state. Usually the bees become sickly, and unable to fly, when the parasites are in the larva state; but they sometimes live till the perfect insect emerges from the pupa. The larva is fixed at the inosculations of the dorsal segments of the abdomen of the bee, and is hardly discoverable by the eye unless the abdomen be dissected. The larva is white, nearly two lines in length, and very much resembles a small worm or maggot. The pupa is nearly the size of the larva, and of a reddish brown color. The perfect insect is a non-descript, and bears very little resemblance to the [*Stylops*] or [*Xenos*] or any other insect, that has been found to be a parasite of the bee or wasp. It is of the class Diptera of Lin.—is little larger than the Hessian fly, but in color and form, it is very unlike that insect.

Kirby, many years since discovered that the insect (*Stylops*) was a parasite in the black-bronze bee, (*Andrena nigroœnea,*) in England, and Professor Peck, afterwards found that the (*Xenos*) was a para-

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* *To Professor Silliman,—Dear Sir.*—Having fully ascertained that we have an insect, that is a Parasite of the Honey Bee [*Apis mellifica,*] and being unable to find any description of it, in any treatise on Entomology, which has fallen under my view, I send you the following communication, on the subject, for publication, in your valuable Journal of Science, &c. should you think it deserving a place.

I am Yours Respectfully.

Fayetteville, Vt., May 15, 1833. MARTIN FIELD.

site in wasps, in America; but I am not aware that a parasite of the honey bee, has ever been discovered till of late, and in this vicinity.

In conclusion, I would most sincerely request those, who have apiaries, to examine their hives during the spring and summer months, and if this parasite is discovered, to investigate the history of the insect, and if possible, to find a remedy for the injury, it may produce.

28. *A Compendium of Natural Philosophy, adapted to the use of the general reader and of Schools and Academies;* by DENISON OLMSTED, A. M. Prof. of Mat. and Nat. Phil. in Yale Coll., New Haven, H. Howe & Co., 8vo. pp. 336.

It gives us pleasure to announce to the public the appearance of this work. It is an abstract of the larger text-book of Prof. Olmsted, published in 1831 and 1832, and now in extensive use as a manual of Natural Philosophy in our Colleges. Omitting the demonstrations, which require too thorough an acquaintance with Mathematics to be intelligible to beginners and to ordinary readers, the author has given us in the Compendium, a copious and interesting digest of the most important facts and principles of the science. We feel assured, that Teachers in our High Schools and Academies, will find this work peculiarly adapted to their wants. Most of the text-books of Natural Philosophy in common use, we can testify from experience, are not suited to the purposes of elementary instruction. They are either superficial and incomplete, on the one hand, or too elaborate and difficult on the other. Those who give any attention to the subject, desire certainly to know at least all the important *results* of the science, but with the mathematical processes of proof, many must dispense. Prof. Olmsted's style is remarkably clear and happy, and his arrangement philosophical and convenient. A very copious Analysis for facility of reference, and for the convenience of the Teacher in the examination of his classes, is prefixed. The work is neatly printed in the octavo form, and illustrated by numerous cuts.

OBITUARY.

1. *Col. George Gibbs.*—The death of Col. George Gibbs, aged 57, took place August 5th, at his seat, Sundswick Farms, Newtown, near New York.

This gentleman, by procuring and importing, during his foreign travels, the rich and extensive cabinet of minerals now in Yale College, conferred on his country a very important benefit. From 1810, 11 and 12, during which years it was opened and arranged, to 1825, he liberally gave the use of it to the institution and the public, receiving, as his only compensation, the satisfaction of observing the great amount of good which was thus effected. In 1825, this cabinet was purchased for Yale College, for twenty thousand dollars: half of this sum was contributed by citizens of New Haven, including one thousand five hundred dollars given by the permanent officers of the College; about three thousand dollars were pledged in New York, seven hundred in South Carolina,* five hundred, each, by two individuals in Connecticut,† and a few hundreds more in other places.

The writer of this notice had extensive opportunities of witnessing the liberal spirit with which Col. Gibbs promoted the interests of science. While he was conferring important benefits, his manners were mild, amiable and unassuming.

It is not improper to mention, that Col. Gibbs was the person who first suggested to the Editor the project of this Journal, and he urged the topic with so much zeal and with such cogent arguments, as prevailed to induce the effort in a case then viewed as of very dubious success.‡ The subject was thus started in November, 1817; proposals for the Journal were issued in January, 1818, and the first No. appeared in July of that year.

For many years previous to his death, Col. Gibbs, occupied with rural cares, retired into the bosom of his family, in his beautiful abode at Hurlgate Ferry. The few papers which he published in Dr. Bruce's Journal, and in the American Journal, only cause us to regret that he did not publish more.

His talents were decidedly of a superior order; his knowledge was extensive and various; his style of writing was simple, concise and comprehensive, and his original observations were judicious and exact.

2. *Dr. William Meade* died at Newburgh, in the state of New York, on the 29th of August. This gentleman, a native of Ireland,

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* Through the exertions of Thomas S. Grimké, Esq.

† One of whom was the late Hon. James Hillhouse.

‡ It was on an accidental meeting on board the Fulton steam-boat, in Long Island Sound, that Col. Gibbs suggested this effort. Dr. Bruce's Journal of Mineralogy had been for some years suspended, and the alarming state of his health forbade the hope that the work would be revived.

spent the last twenty five years of his life in this country. He was well known as an active mineralogist. He visited many of the most important American localities of minerals, and by his activity in collecting and exchanging minerals, both in this country and in Europe, as well as by his valuable papers in this Journal and in other publications, he contributed to promote the progress of science, and especially of Mineralogy, towards which he ever manifested a decided and warm interest. Dr. Meade left a valuable and extensive collection of minerals and fossils at Newburgh.

Dr. Meade had occupied himself, during some of his later years, on the subject of artificial mineral water, and especially in preparing powders to imitate those of the Congress spring at Saratoga,* and in inventing and perfecting a magnesian aperient, which is, at the same time, effervescent and grateful. These preparations, we are persuaded, are of serious utility, and will be offered for sale to the public.

We have, more frequently than we could wish, the painful duty to discharge, of naming departed coadjutors in our labors.

The late Dr. Felix Pascalis was of this number. He was a native of France, and emigrated to this country during the stormy times of the French Revolution. He died at New York, on the 22d of July last, aged 72.

We have not the materials nor the space to speak of him, except as a man of an ardent and vigorous mind, enriched by large cultivation—active in promoting useful knowledge, and warm in his personal attachments.

He was, for many years, an efficient and able editor of our earliest medical journal, in which cause he labored with the late eminent *Dr. S. L. Mitchill*, of whom Dr. Pascalis gave a full and interesting biographical and commemorative eulogy.

Dr. Mitchill also contributed many valuable papers to this Journal, and will always be remembered with honor, as a very active and efficient mover and cultivator of useful knowledge in this country. His large correspondence and extensive personal intercourse, operated with great effect in exciting others to similar efforts.

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* Dr. Meade, many years ago, published a valuable work on the waters of Ballston and Saratoga, and on the use of mineral waters generally. The last paper which he published in this Journal was on the same subject.

THE

AMERICAN JOURNAL OF SCIENCE, &c.

Art. I.—*Ten Days in Ohio; from the diary of a Naturalist.*

Introductory Remark.

The following observations are taken from a diary, kept while on a journey from Marietta to Circleville, with my family, in May 1832; some facts, in relation to the canal, have been since added. As all cannot visit Ohio, these remarks may be interesting to those whose duty or inclination confines them at home. As Marietta is embraced in the first day, it would be unfair to leave it without a passing remark.

MARIETTA.

This town, where the diary commences, is located at the confluence of the Muskingum with the Ohio river. The scite of the town is partly on the river bottoms, and partly on an elevated plain. The Muskingum river divides it into two unequal parts, the larger of which is on the east side. On the verge of the plain, near the Muskingum, and half a mile from its mouth, was seated "Campus Martius," a strong stockaded fort, built by the Ohio Company; and the residence of the early settlers during the Indian war, which soon followed the occupation of the country. On the west side of this beautiful river, was seated Fort Harmar; so named in honor of Gen. Harmar, the builder and commander of the fort. Drawings of both these interesting structures are in the possession of the writer, and will at some future day be published, as valuable memorials of fortresses long since crumbled into dust. Back of the elevated plain, the country rises into hills, two hundred and fifty feet above the bed of the river; they are formed of an argillaceous earth, based on sandstone rocks; they are clothed near their tops with beautiful forest trees, and surround the town on the north and west like a Roman amphitheatre. The plain is about a mile in length, and half a mile in breadth, and at least one hundred feet above low water; affording ample room for a considerable city, beyond the reach of the highest floods. The ground is composed entirely of alluvial materials, and was once evidently the bed of the Muskingum. On this elevated plain, stand those ancient works, (described in the Archæologia Americana,) the interesting monuments of that half civilized race who once peopled the fair valleys of the west, and whose history lies buried beneath their ruins. The name of Marietta, is derived from that of Mariè Antoniette, the beautiful but unfortunate queen of France; and was given in grateful remembrance of her kindness to these U. States, when struggling with poverty and oppression. The town was laid off and settled by the agents of the Ohio Company, in the year 1788, and is the oldest in the state. It contains one thousand house lots of one third of an acre each, with wide airy streets and spacious commons. These, the inhabitants have, within a few years, ornamented with many of our most beautiful forest trees, which, with the grassy commons, give it a cool and refreshing aspect during the heats of summer. The principal part of the inhabitants are of New England origin, and still inherit the habits of good order, industry, morality, and love of social intercourse, so common in the land of their forefathers. "Support Religion and Learning," was the motto on one of the first public seals used in the town. The present number of inhabitants is a little short of one thousand five hundred. The public buildings are four houses for worship, a court house, market house, banking house, library building, female academy and collegiate institute. The court house, bank, and collegiate institute, are neat specimens of architecture. The library building is a handsome brick edifice, built by the Marietta Library Association. The upper story is occupied as a public hall, by the members of the Lyceum and other societies. The lower story contains the books, and is also intended for a public reading room. Marietta has two public libraries of respectable size. The private dwellings are generally built of brick; many of them finished with taste and neatness, and embellished with handsome door yards, and gardens of shrubbery, both of fruits and flowers. It contains stores, mills, a post office, foundery, printing office, boat yard, &c. &c.

The edifice for the "Collegiate Institute and Western Teacher's Seminary," is built of brick, seventy five feet in length, and forty feet in breadth, four stories high with a basement story, intended for a kitchen and eating rooms. The system of education is connected with that of manual labor.

The young ladies' academy has been established two or three years, and is in a flourishing condition. The two departments are under the direction of nine trustees, with corporate powers. The cost of the buildings, library, apparatus, &c. was about $8,000, which was raised by donation from the inhabitants of Marietta and the vicinity.

MARIETTA TO ZANESVILLE.

The road from Marietta to Zanesville, for the first twenty miles, passes up the valley of the Muskingum, is composed entirely of rich alluvion, and varies in width from half a mile to a mile between the hills which line each side of the valley.

The river is about two hundred yards in width, and of sufficient depth for steam boat navigation, a part of the year, and for "keels" at all seasons. It holds a devious course through the valley, sometimes visiting the base of the hills on the east side, and sometimes on the west, leaving barely room for the road, constituting what is called "narrows," while on the opposite side is found a wide "bottom." These bottoms are converted into beautiful farms, and produce abundant crops of grass and grain. Fruit trees grow with wonderful rapidity. An apple tree is now standing a little way above the mouth of Coal Run, twenty miles from Marietta, which, at the age of thirty years, was three feet in diameter, a few feet from the ground, and produced apples, in one season, sufficient for twenty barrels of cider. Allowing seven bushels to a barrel, we have one hundred and forty bushels of apples, a prodigious quantity for a single tree.

Twelve miles above Marietta, we crossed the mouth of Bear Creek, in a "flat boat," the bridge once erected here being removed by a flood, and the "back water" from the Muskingum being too deep to admit of fording.

Two miles further up we crossed Cat's creek, on a bridge. The early settlers often named the streams from some incident or feat, in hunting, which took place on its waters, instead of retaining the names of the aborigines, which are much more harmonious and significant.

The bottoms between these two streams are wide and rich. The crops of wheat look well, but the Indian corn is barely appearing above ground, and looks pale and sickly. The farmers generally complained of the damaged condition of their "seed corn," so that they have, in many instances, replanted their fields two or three times. This defect in germinating, was doubtless owing to the sudden and unexpected invasion of winter, early in November, before the corn was sufficiently dry to bear hard freezing without injury to the vital principle. There was also a marked difference in the vegetative powers of corn raised on old cultivated lands, or on new lands just cleared; that from the old lands being ripe two or three weeks before that on the new, when planted on the same day. It is explained by the well known fact that the more succulent and luxuriant growth of the plants on new lands runs up tall and slender, and is therefore less disposed to form seed early, than the growth of soils a little exhausted by cultivation.

Two miles above Cat's Creek, we passed Big Run, by a ferry, and two miles further on we came to Coal Run, a small branch rising in the adjacent hills on the east side of the river.

Coal.

Coal Run takes its name from a stratum of bituminous coal, found at the mouth of the creek, and also in the bed of the Muskingum, extending for a mile or two up and down the river, and entirely across it.

The coal, lying on a bed of white clay, is about two feet in thickness, and very pure. In low water, the coal diggers anchor a boat in the stream, and with crow bars entered in the seams of the coal, pry up large masses, which they break into pieces of a size easily handled, and then load into the boat. It is worth on the spot when dug, about three cents per bushel, and when delivered in Marietta, five cents. At present, most of the coal is dug from a bed, seated about sixteen feet above that in the bed of the river, near the base of the adjacent hills, by means of tunnels run horizontally into the coal deposit. The road here passes through "the narrows" for nearly a mile, with a space barely wide enough for a carriage. It is about forty or fifty feet above the river, and crosses over several of these tunnels, which, starting near the river, run directly under the road into the bowels of the hills. The elevation of the hills is about two hundred feet. There is a thick stratum of sparry limestone, free from organic remains, resting on the coal deposit with thick beds of sandstone above, covered with argillaceous earth, and clothed with a heavy growth of forest trees, principally white and black oak, with sugar tree, amongst the decomposed limestone soil. The deposit of coal and slate in this bed is about six feet in thickness, divided near the upper part by a horizontal bed of slate of eighteen or twenty inches. This makes it rather tedious digging, as the slate has all to be removed and thrown to one side of the mouth of the tunnel, or it would soon block up the narrow avenues between the pillars left to support the roof of the mine. The coal is not so bituminous as in many deposits, containing a considerable quantity of iron pyrites, but it burns very well. The perpendicular fracture, as it lies in the bed, is vitreous and glistening; its horizontal one is dull, showing the fibrous structure of wood; and between the contiguous laminæ, is a coating of pure carbon, the thickness of brown paper, seeming to indicate that these beds were formed from decomposed trees. An additional proof of the truth of this supposition is found in the absence of all fern impressions on the slatestone lying over and between the coal.

Near the mouth of Coal Run, the road leaves the valley of the Muskingum, and we see that beautiful river no more until we reach Zanesville, after passing over the ridges and hills common to all the sandstone formation in Ohio.

WATERFORD.

We are now in Waterford, a township in the N. W. part of Washington, bordering on Morgan County. It was amongst the earliest settled townships in the State, being commenced in 1789, and formerly contained within its limits the settlement at Big Bottom; well known in the early history of the country, from the massacre of fourteen of the inhabitants by the Indians, in January 1791: the block house was burnt and the settlement abandoned until the peace of 1795. About a mile above Coal Run, we passed over a part of the farm of Mr. B. Dana, consisting of more than one thousand acres under fence, and mostly well cultivated in meadows, corn lands and pasturage. He annually shears from one thousand to one thousand two hundred sheep, most of them fine wooled; and in good seasons, makes four thousand pounds of excellent sugar from the juice of the Acer saccharinum. Cattle, hogs, meadows, orchards, dairy, and crops of grain and hay are all in the same princely style. His buildings are in the best condition; a large brick dwelling house, at least fifty feet long and two stories high, is completely covered in front by the wide spreading branches of two multiflora rose-bushes from our native wilds, which, in the season of flowering, afford a most beautiful and magnificent spectacle. So completely multiflora is this native rose, that I have counted from sixty to eighty buds at the termination of a single branch. Four miles from Coal Run, we come to Olive-

Green Creek, which we crossed on a bridge about twenty yards in length. Its borders are skirted with many fine farms, and a small thriving village seated on the western side near the base of a large hill, assists much in beautifying the landscape. In some places, cliffs of sandstone form the banks and sides of the creek, and as we ascend the hill, and a thick deposit of sparry lime rock crops out by the side of the road more than one hundred feet above its bed. This stream, like most others in Ohio, took its name from an incident which happened on its borders. About the year 1794, an exploring party was fitted out at Marietta, to examine the northern portion of "the Purchase," and to search for salt springs. They encamped, the first night, on this creek. Two of the party, Col. Robert Oliver and Griffen Greene, Esq., strayed from their companions, and became so bewildered and lost that they could not reach the camp that night; and as the Indians were still hostile, some apprehension was felt on their account. However, they reached the rest of the party the following morning in safety. From this circumstance, the creek was called "Olive-Green." It is a stream about sixty feet in width, and twenty miles in length, having on its head branches, some fine lands and rich settlements. In its waters are found the most rare and perfect bivalve shells of any in this region, especially those of the genus Anadonta. Its bottom is argillaceous, and the cuticle of the shells is uninjured by the abrasion of sand or gravel.

The line between Washington and Morgan Counties is a little west of the bridge.—Eight miles beyond Olive-Green creek, the road passing over high lands but which are tolerably rich, level, and just coming into cultivation; we then reach Meigs's creek, so named by the same party after its discoverer, Col. R. J. Meigs, a soldier of the revolution, and one of the commanders under Montgomery in the invasion of Canada; the father of the late Return J. Meigs, Gov. of Ohio and Post Master General. It is favored by two principal branches, called the east and west forks, and which when united make a large beautiful creek, affording along its borders many fine scites for mills, and for extensive settlements.

Coal.

As we go down from the highlands on the east side of Meigs's creek, a bed of stone coal comes to the surface about fifty feet above the bed of the creek. The owner of the land informed me that the same stratum appeared about eighty rods further up the stream, where it is five feet in thickness. He had used it for several winters in his house, and preferred it to wood, which grew in plenty near his door. Directly after crossing the creek we ascend a long slope of a hill side, to the uplands.

Channels of Creeks and Rivers.

The beds of the creeks in the hilly parts of Ohio, being invariably found from fifty feet to two hundred feet below the general level of the country, increasing in depth as they approach the large streams, and diminishing towards their head branches, until they terminate near the top of some ridge, afford strong support to the opinion that this was once a level region, and gradually brought into its present broken and confused state by the wash and abrasion of the streams during the long succession of ages, since its emersion from that ancient ocean, which once covered the region now called " the Valley of the Ohio.

After the ocean left it, many ages must have passed before it was covered with forest trees, and during this period, it is probable most of the water courses and rivers were formed and abrasions took place. Changes equally interesting have occurred in our forests. Large tracts of country were once covered with pine timber, where now not a solitary tree is to be found for many miles around. Its place is supplied by the different species of oak and other trees. We have all the proof we can ask of the fact in the thousands of pine knots which lie mouldering under the leaves; and the spots most favorable and most used for the manufacture of Tar, are now covered with a heavy growth of oak. Another proof of pine, once having been the prevailing timber amongst the forests of the hills, is found in the charcoal taken from mounds and tumuli, being almost invariably the product of pine wood. Four miles beyond Meigs's creek, and thirty two from Marietta, we passed the night with a very hospitable and kind innkeeper. In the course of the day, observed many wild flowers beside the road. The Prunus Virginiana and Ribes villosa in full bloom. Podophyllum peltalum nearly out of bloom. The root of the latter affords an excellent cathartic, and the fruit of the former, a delicious food and valuable medicine in bowel complaints.

May 23d.—The morning was cloudy and rainy, took an Ohio breakfast of bacon, coffee and good bread and butter, before starting. The road for about twenty miles, passes along the dividing ridge between the east and west branches of Meigs's creek, forming a natural turnpike, in some places, of only a rod or two in breadth. On the more elevated portions of the ridge, many fine views of the adjacent country are found; the horizon being extended to the distance of ten or fifteen miles, a favor seldom afforded the traveller in this part of the state. The surrounding region is generally settled; and farms and recent "clearings," appear in every direction. From the passage of Meigs's Creek at Stevens', not even the smallest branch crosses the road, until we reach the waters of Salt Creek, a distance of twenty miles. The road being slippery from the rain on the argillaceous soil, we did not reach Chandlers, a distance of seventeen miles, until 12 o'clock A. M. In the valley of Salt Creek, at the foot of this long ridge, is situated a pleasant little village, called Chandlersville.

Muskingum Mining Company—Fruitless Exploration for Silver.

It is also a memorable spot as the scene of the operations of the "Muskingum Mining Company;" occasioning "day dreams" of wealth; and a thirst for speculation equal in intensity, though not in extent, to the celebrated South Sea project, got up many years ago in London by John Law and associates. Our Ohio bubble, however, was not so disastrous in its explosion; the loss falling generally on those who were able to bear it without much injury.

While our dinner is preparing, I will narrate the principal facts, as I think I have a right so to do, having been one of the original Stockholders. Early in December, A. D. 1819, an intelligent physician, who then lived at the mouth of Cat's Creek, a stream we crossed yesterday, in journeying to Zanesville, passed the night at Mr. Chandlers, the owner of a salt well then in operation, near the foot of the long ridge, on a small branch of Salt Creek. The doctor having some taste for Mineralogy and Chemistry, was enquiring of Mr. Chandler, as they sat conversing together by the fire in the evening, how many different kinds of rock he had passed in boring his well. It was about four hundred feet in depth; and among other strata passed, he said there was one at one hundred and twenty feet of intense hardness, so much so, that they could bore only an inch, or even less in a day. While passing through this rock, a distance of six or eight feet, the pump brought up several small pieces and particles of a metallic substance, so pure as to be malleable, flattening under the hammer. They had tried to melt it in an iron ladle, but could not. Although several years had passed, he thought that by searching he could still find some small bits in the earth that had been brought up and emptied out near the well. In the morning they visited the spot, and were so fortunate or rather unfortunate, as to find several small bits the size of half a wheat corn. On the doctor's arrival at Putnam, a town opposite to Zanesville, the specimens were put under the blowpipe and furnished a handsome button of very fine silver, equal in purity to a Spanish dollar. On further conversation with Mr. Chandler, he thought, as near as he could recollect, that the same material had been brought up for the distance of several feet; leading to the conclusion, that the vein of silver was five or six feet in thickness. On communicating these facts to another physician in Putnam, a man of considerable science, and great mechanical ingenuity, he became so fully convinced of there being a large body of silver in that spot, that he forthwith visited Columbus where the Legislature were then in session, and procured an act of incorporation for a company, by the name and style of the "Muskingham Mining Company;" with ample powers for conducting mining opertions. For the privilege of working the mine on the salt section, belonging to the State, the company were to pay into the State Treasury, fifteen per centum of the net proceeds. The capital was $50,000, divided into one hundred shares of $500 each. The stock was soon taken up, as it was thought that six or eight thousand dollars would sink the shaft one hundred and twenty feet to the silver, and after that, it would pay its own way. Before commencing the shaft, a fresh examination was made, by letting down the boring rods, to which was attached a steel scraper, with suitable springs. At the depth of about one hundred and twenty feet, a spot six feet in extent, was found exceedingly hard and smooth; while all above or beit was either soft, or gritty. When the rods were brought up, several particles of silver were found in the bottom of the scraper, sufficient to turn out a small button from the blowpipe. It was repeated several times, and always with particles of silver. Therefore, it was considered as almost certain, that a bed of pure silver, several feet in thickness, was actually seated at that depth. A shaft was commenced of an oval form, of the dimensions of eleven feet by eight, and sunk to the depth of one hundred and forty feet. In prosecuting the work, serious difficulties arose in keeping out the water, which rushed in through the crevices of the rock; but the ingenuity and perseverance of the superintendant, assisted by a cast iron force-pump, worked by horses, overcame all difficulties. The shaft was opened about forty feet from the salt well. The first twelve feet were composed of red argillaceous earth, covering the strata of rock. The next forty or fifty feet, were a kind of greywacke, decomposing after exposure to the vicissitudes of the weather—then sandstone of a slaty structure—then bituminous shale, with thin layers of stone coal—at one hundred and ten feet, numerous geodes, coated with shale, were found, containing bivalve shells; below these, impressions of Palm leaves between the seams in the slatestone. I have now in my possession several specimens of the rock strata, from one hundred and ten feet to one hundred and forty feet; one of these is a fine grained, dark clayslate, from the extremity of the drift, where the operations ended—at one hundred and twenty feet they struck a bed of grey flint rock, six or eight feet in thickness; at this depth the object of their search was expected to be found, but no silver yet greeted the eyes of the anxious miners, although every fragment was examined with minute attention. Beneath the flint rock was a stratum of dark argillaceous slate, so compact that no water, after passing the flint stratum, penetrated the walls of the shaft. The shaft was continued twenty feet further in the slate rock, making one hundred and forty feet from the surface; a drift was then commenced and carried forward forty feet, until it struck the salt well; this the miners had previously plugged with great care, below the principal salt spring. No silver, as yet appearing, an examination was made by digging down the sides of the salt well in the floor of the drift, and a bed of very fine bituminous coal seven feet in thickness was found. But as coal was not the object of search, the miners made an attempt to reach the spot, where the silver was brought up by the scraper, now about fifteen feet above the roof of the drift. In this attempt, some unlucky blow, or the concussion of a blast, set loose the plug in the salt well over their heads; when the water came rushing down with such violence, that they barely escaped drowning before reaching the buckets, and were immediately drawn up; the water following them rapidly to within forty feet of the surface of the earth. So sudden and unexpected was the rush of water, that their tools were all left behind; and the cast iron pump, valued at more than one thousand dollars, still remains in the mine; a lasting memorial of the enterterprise of the citizens of Ohio. To prevent accidents, the shaft has been since filled up with earth and old logs. The expenditures of the company amounted to about $11,000, several hundred dollars being recovered from them in damages, for ruining the salt well. As the shaft approached near the supposed silver deposit, the stock rose very rapidly in value; a share on which fifty dollars had been paid, selling for two hundred and fifty; as it had been deemed very doubtful whether a shaft could be sunk to that depth, on account of the supposed difficulty in keeping out the water. Thus in one fatal hour, the silver dreams of the anxious stockholders, vanished into thin air; and it remains to this day, a sober problem, for naturalists and mineralogists to solve, whether native silver was ever found* in a secondary formation, belonging in this instance to the coal formation; or whether the evil genius, who is said to preside over mines, fearful of losing his charge, knocked out the plug of the salt well, to be revenged on the invaders of his dominions. The stratum in which the silver was supposed to be deposited, is without doubt, the same found in sinking salt wells on the Muskingum river, fifteen or twenty miles S. W. of this spot, and described in the 24th. Vol. of the Journal of Science, in an article on the "saliferous rock formations, of the valley of the Ohio."

We left Chandlers at 3 P. M., crossing Salt Creek on a neat, covered wooden bridge, supported by piers of cut stone. It is here about thirty yards wide, and unites its waters with those of the Muskingum, nine miles below Zanesville. It is a turbulent little stream, and, before the bridge was built, was, in rainy weather, the dread of all travellers. On its waters are many fine settlements and excellent farming lands. Three miles east of Zanesville, we came upon the National Road. It was in fine condition, and as smooth as a floor; our horses, forgetting that they were attached to a heavy carriage, moved on it with much freedom. The State has taken it in charge, as far as it is finished in Ohio; appointed a superintendant, and levied a small toll, sufficient to keep it always in good condition. We reached Zanesville a little before night. By the road-side on Salt Creek, we saw many plants of the teazle, (Dipsacus fullonum,) growing wild. Black haw in full bloom. Afternoon showery and cold, making our cloaks quite comfortable.

MORGAN COUNTY.

May 24.—Morgan County, through which we have just passed, lies on the Muskingum River, between Washington and Muskingum Counties. The general face of the country is hilly, but the soil is rich, producing fine crops of all the cereal grains. Its greatest wealth, however, is found in its inexhaustible salt deposit; affording

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* It is not for us to say, what was the source of the small particles of silver, supposed to be discovered here; some specimens of the so called silver rock, which we received while the exploration was going on, presented no indications of silver —*Ed.*

already nearly four hundred thousand bushels per annum. The county is thirty two miles long from east to west, eighteen miles broad from north to south, and contains about thirteen thousand inhabitants. McConnelsville, the seat of justice, is a thriving town, seated on the left bank of the Muskingum, twenty five miles below Zanesville, in the midst of the salt region.

ZANESVILLE.

Zanesville is the county town for Muskingum County, and lies on the east side of the river, about seventy five miles from its mouth. It stands on the sand rock formation, at the falls of the Muskingum, in a most picturesque and beautiful region. The town is named after Ebenezer Zane, one of the earliest and most enterprising pioneers of the west; and the town plat, being a mile square, was granted by Congress to Mr. Zane in 1796, in consideration of his surveying and laying out a road on the most eligible route between Wheeling, in Virginia, and Limestone, in Kentucky. His perfect knowledge of the country, obtained in his hunting excursions, enabled him to do this in the most satisfactory manner. The town was surveyed and laid off into streets and lots, about the year 1800, and in 1803 contained only ten families, within the town plat. It is now one of the most thriving and business-like towns in the state; embracing a population of about four thousand souls. Its immense water power for mills, and the vast deposits of coal and iron found here, give it superior facilities in many kinds of manufactures. The inhabitants have improved these advantages, and iron works, flour mills, cotton and woolen, and glass manufactories, &c. are in operation on every side. A canal, cut through the sand rock stratum, across the bend made by the river at the falls, affords, by means of lateral cuts, invaluable water power. The bed of the river, at the falls, is composed of a dark colored, very compact limestone, highly impregnated with iron, and is sometimes used in the neighboring furnaces with other ores. The superior density of this rock, has doubtless occasioned and preserved the falls where they now are. Had they been of sandstone, like the deposit over it, the continual wear of the waters, would, ages ago, have reduced the falls to a mere ripple.

Coal.

Above the sand rock, in the adjacent hills, which here rise about two hundred feet above the bed of the river, are found beds of bituminous coal, alternating with loose clay slate, limestone and sandstone. The lower beds of sandstone contain many interesting vegetable impressions, and the upper limestone many fossil shells of the genera Terebratula, Productus, &c. and in the lower strata, madrepores, encrinites, and various zoophytes. Among the vegetable impressions in the sandstones, and over the coal beds, are found many species of ferns and palm leaves, with Calamites dubius, Lepidodendron crenatum, Poacites lanceolata and Neuropteris Grangeri; the latter so named by Mons. Brongniart, in honor of the late Ebenezer Granger, Esq.,* a distinguished attorney and citizen of Zanesville, but now deceased. To an acute and discriminating mind, gentlemanly and endearing manners, Mr. Granger added a rare taste for the study of natural history; especially that portion of it embraced in fossil organic remains. In excavating and blasting the sand rock in the canal around the falls of the Muskingum, many interesting and curious casts, and impressions of that ancient order of extinct plants, which once decorated the earth, were brought to light, and drawings of them taken, under the direction of Mr. G. A large box of these fossils was packed up and consigned to M. Brongniart, but were unfortunately lost, by the sinking of the boat in the Mississippi River. The drawings, however, reached him in safety, and afforded several new species to his catalogue of fossil plants.

Atheneum.

Amongst the public institutions of Zanesville is the Atheneum. It is kept in a handsome brick edifice, built expressly for the purpose, near the center of the town. It contains a valuable library, and a handsome collection of minerals and fossil organic remains. Among the latter, are some very rare and interesting articles, found in excavating the Ohio Canal. Of these, the head and horns of an aninal, supposed to be an extinct species of sheep, very well preserved, is a great curiosity. The horns are nearly square and undulating, and stand nearly at right angles with the head. It was found, with two others, at the depth of twelve or fourteen feet, resting on diluvial gravel and pebbles, where the canal passes from the Muskingum Valley into that of the Licking. Several bones of the mastodon were found at the same time.

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* See Vol. III. p. 5 of this Journal, for a notice, with drawings, of a collection of coal plants, furnished by Mr. Granger, and forwarded by the Editor to M. Brongniart.—*Ed.*

Religious Denominations, Schools, Bridges, &c.

The religious sects are Presbyterian, Baptist, Episcopalian, Methodist and Roman Catholic, all of which have very good houses, well filled on the Sabbath. Public and private schools are liberally supported, giving evidence of a moral and enlightened people; and three well conducted presses, supply them with food for the mind. The National Road passes through the main street and crosses the river on the upper bridge, built opposite the mouth of Licking Creek, to the right and left banks of which it throws a branch, one passing to West Zanesville, above the mouth—the other below, in the direction of the turnpike. The lower bridge crosses to the town of Putnam, on the west bank of the river. They are both built of wood, supported by handsome stone piers, and covered with roofs to prevent the decay of the timber. They pass directly over the most rapid and tumultuous portions of the falls, giving a wild and terrific grandeur to the view, through the loop holes in the sides of the bridge. A little above the lower bridge, "Putnam Hill" lifts its precipitous sides to the height of two hundred feet above the bed of the river; affording barely room for a road to pass between it and the river, at an elevation of sixty or eighty feet. The top of the hill embraces several acres of level land, and furnishes one of the most enchanting and beautiful prospects of the river, adjacent hills and villages, that I have ever seen. A section of its side next the river, exhibits an interesting view of the geology of the region.

PUTNAM.

On an alluvial plain, south and east of this hill, bordering the Muskingum, lies the town of Putnam. It was formerly called Springfield, and was laid out under the direction of Gen. Rufus Putnam, one of the principal proprietors, in the year 1801. It now contains about one thousand inhabitants. The heads of families are many of them from New England, and still retain the manners, habits and industry, of that peculiar people. A very extensive flour mill is seated at the foot of the falls, below the bridge. It is among the earliest establishments of the kind on the river, and Whipple & Putnam's brand on a flour barrel, is a sure passport for its sale, in all the towns along the shores of the Mississippi.

COUNTY OF MUSKINGUM.

The county of Muskingum is twenty seven by twenty eight miles square, and covers a space of six hundred and sixty square miles.

The general face of the country is hilly; but the industry of its inhabitants has filled it with valuable and productive farms. Its principal agricultural prosperity is derived from the crops of wheat, which are fine and abundant; and they are made so, chiefly, by the system of "clovering." This grass affords excellent pasturage for cattle, sheep and hogs; and when turned under the earth, greatly improves the soil, and after one or two changes, reappears in the form of dollars and eagles, to enrich and repay the labors of the husbandman. Other sources of wealth lie deeper in the earth, and are found in the salt, the coal, and the iron; each of which annually yields many thousand dollars to the capital of the county. The present population amounts to thirty two thousand.

Moxahela Creek, and its geology.

Soon after leaving Putnam, on the great western road, we come into the valley of the Moxahela Creek, and travel along its borders for several miles. It rises in Perry County, and running in a north easterly direction across a part of Muskingum County, falls into the river three miles below Putnam. It is a handsome stream, about thirty yards in width. The present inhabitants, without regard to euphony, or the prior right of a much more harmonious name given it by the aborigines, call it "*Jonathan's Creek.*" The bed is composed of shelly limestone, worn down into the solid rock, four or five feet, by the abrasion of its waters. The surface of the rock is regularly divided every six or eight feet, by horizontal seams, several inches wide, running in a south westerly direction, the whole width of the creek, and doubtless continues under the adjacent hills. They have the appearance of cracks, made by the contraction of a semi-fluid body passing into a solid state. Immediately over the lime-rock is a deposit of sandstone, tinged by a pale yellow oxide of iron; rather loose in texture, and abounding in casts and impressions of various fossil plants; especially of those described by Mr. Parkinson as Phytolithus, and extending south westerly through Perry County. The inhabitants and quarrymen call them "snake stones," from the impressions on the surface resembling large scales, and from their cylindrical form. In the same locality, it is said the leaves and the blossoms of the tropical palm tree, have been found, beautifully impressed in the rocky bed. Eight miles west of Putnam, we passed through a small village called Bridgeport, seated on the north branch of the Moxahela.

PERRY COUNTY—*productions.*

Not far from this spot is the eastern boundary of Perry County, ten miles from Somerset, the seat of justice for the county. The road passes over a most interesting and picturesque country. The hills are rounded and broad, and under fine cultivation. The most common forest trees are beech, sugar tree and white oak, with an abundance of the Cornus florida, or dog-wood. The soil in this county is a rich loam, of a light amber color, loose and friable, made up of decomposed argillite, sandstone and limestone, in such proportions as to resist drought, or absorb wet, when too abundant; and produces the finest crops of grain, clover, yellow leaf tobacco and fruit trees. The valleys and hill sides, afforded many a delicious treat to the eye, in far extended fields of blossomed clover and verdant grain. The "yellow tobacco" is becoming a valuable article of culture, and several hundred hogsheads are annually grown in this country. Five or six years since, the *Tobacco mania* prevailed among the farmers, in all the hilly portion of the state. Many of them thought it the sure road to wealth, and neglected other crops for that of the "yellow leaf." Almost every one entered, more or less, into it, and the merchants encouraged the cultivation. The consequence was, the overstocking of the market; the reduction in price from twenty dollars per hundred to two or three dollars, and the ruin of many dealers in the article. But it is said, trade will regulate itself. Tobacco is now in demand; and while a limited number only cultivate the "aromatic weed," it will continue to be a profitable crop. Virgin soil, the natural growth of which is white oak and dog-wood, is found to produce the finest tobacco. The average crops of grain, are twenty or twenty five bushels of wheat, forty to fifty of corn, thirty to forty of oats, and two hundred of potatoes, to the acre. Less attention is paid to the improvement of the soil in this county than in Muskingum, where the land is regularly prepared for a crop of wheat, by plowing in a heavy growth of red clover. This is found to afford the very best nutriment for the wheat plant, producing the fairest and heaviest grain; and accordingly, Zanesville, where most of the wheat is manufactured, on all the waters of the Mississippi, where the article is principally sold, is noted for its superior flour.* The soil of Muskingum is naturally thin

* Three years ago, seventy three thousand barrels of flour were made in Zanesville; the production of one season.

and light, but the general cultivation of *red clover*, has, within six or eight years, actually doubled the agricultural wealth of the county.

Flint-ridge.

One mile east of Somerset, the road commences crossing that singular formation in the geology of Ohio, called "Flint-ridge." The deposit shows itself in large black flinty masses, about half way up the side of a long hill, cropping out by the side of the road for some distance. It is harder, and also much darker colored, than that used in the manufacture of mill stones, on the Raccoon Creek, in Jackson County, or on the heads of Moxahela; but is of the same formation, being mixed with a portion of lime. A deposit of sandstone lies over it, higher up the hill. It does not show itself again, until we are about a mile west of Somerset, when it crops out anew on the western declivity of a hill, in the same manner as on the east side, embracing the width of about two miles. Its general course is from north east to south west, passing through the counties of Coshocton, Licking, Muskingum, Perry, Hockhocking and Jackson, and probably into the "knobs" and barrens of Kentucky. In Hocking County, it seems to have been deposited in a fine siliceous paste, of various colors, from a pure white to yellow, clouded and black; and is considerably used in manufacturing hones and stones, similar to "oil stone," for the use of the cabinet maker and joiner. In Jackson and Muskingum Counties, it is extensively manufactured into all the various forms of mill stones, equal to the best French buhrs, which are in great demand through the western states. The whole deposit abounds, more or less, with the casts of fossil shells, beautifully replaced, in many instances, by pure quartz; some are wholly studded over with drusy crystals, others filled with chalcedony, and quite translucent.

The various families of Producti, Ammonites, Nautili, Encrini, &c. with many undescribed species, are here presented, as the historic medals of geology, designed and impressed by the Creator of all things. I have a Productus, (beautifully coated with minute crystals,) which, on breaking the shell, exhibited the animal reduced to about two thirds of its original size. The shell is two inches in breadth, one inch and a half in length and about one and a fourth in diameter, and is the most beautiful petrifaction I have ever seen. I have also, from the same locality, a very interesting fossil, which may probably have been the pedestal or stem of an encrinital animal. It is nearly six inches in diameter, a perfect circle in outline, and two inches thick on the outer portion of the circle. The centre is depressed in the form of a cup, three inches across the top, and more than an inch deep, leaving the outer circle, or sides of the fossil, one inch and a half thick. The outer margin is armed with spines, three fourths of an inch high, and uniting with each other at their base, fourteen in number, resembling the figure of an imperial crown; the depression in the center is lined with the same number of spines of a smaller size. The outer margin, or side and upper surface, are smooth, and were probably covered with a cuticle, now replaced by a coat of quartz, one line in thickness. Two of the spines are broken; these two are filled with beautiful crystals; the main body of the fossil is composed of cellular quartz or buhr stone. A little more than one half of it is perfect; the other part was lost by the workmen, in separating it from the rock.

As to any reasoning on this singular deposit, it must be altogether speculative. It was probably made when the valley of the Ohio was covered by an ocean, and from water at the boiling temperature, as cold water holds but a small quantity of silex in solution, and here was a vast body of it.* M. Humboldt, in his travels on the coast of Colombia, makes mention of water issuing, boiling hot, from the bottom of the ocean, where the sea is now three hundred feet deep, and a mile or more from the shore.

The dip of the rock strata to the south on the Muskingum river, would indicate a force acting from below and raising the superincumbent formations. At this period, a rush of heated fluo-silicic gas, or of boiling water from the interior, might have thrown down this deposit, composed of fine silicious particles, intermixed with more or less of lime. In many places, it abounds in jasper, hornstone, flint, quartz, chalcedony, &c. of various and intermingled colors, giving strong evidence of their having been once in a state of fusion. It needs the inspection of an experienced geologist to give a satisfactory history of this interesting formation.

Tumuli.

The hill country in Perry County appears to have been thickly inhabited by that ancient race of men, who have left so many relics of

* It is certain that silex has been held in solution, in vast quantities; the sulphuret of silicon, the base of Silex, is very soluble: the earth itself is soluble in fixed alkalies and in fluoric acid, and these agencies, like most of those which are chemical, would be rendered more active by heat. Silex is held in solution in the hot alkaline volcanic water of the Geyers in Iceland—also in the Azores and other volcanic regions.—*Ed.*

their industry and their power in the west. Numerous tumuli, of various dimensions, are seen near the road side; the sacred repositories of the dead, and lasting mementoes of the affection of the survivors for these silent tenants of the tomb.

Cattle—their food.

We met, to day, several large droves of fat cattle, on their way to an eastern market; some of them going as far as New York. They are collected in Illinois, Indiana, and Ohio, and are herded for a season or two on the rich praries of the west. During the winter months, they are fed on hay and Indian corn cut up with the stem and foliage before the grain has become hard, and placed upright in moderate sized shocks; it dries without mouldiness, and makes one of the most succulent and nutritious articles of food for cattle. In Ohio, thousands of acres are cultivated for this express purpose.

Western Emigration—great thorough-fare.

We met many emigrating families, on their way to "the St. Josephs," a celebrated district in the Michigan Territory; and the present "land of promise," to all who, from the northern and middle states, are seeking a better country. The road we are now travelling, was for many years, from 1800 to 1815 or 16, the *great thorough-fare* between the states of Kentucky, Indiana, Ohio, and the eastern states; or until steam boat navigation created a new era in the history of travellers—a perpetual stream of emigrants rolled westward along its course, giving constant occupation to hundreds of tavern keepers, seated at short distances on its borders, and consuming all the spare grain raised by the inhabitants for many miles north and south of its line. Groups of merchants, on horseback, with led horses, laden with Spanish dollars, travelled by easy stages, every spring and autumn, along its route; congregated in parties of ten or twenty individuals, for mutual protection, and armed with dirks, pocket pistols, and pistols in holsters; as robberies sometimes took place, in the more wilderness parts of the road. The goods, when purchased, were wagoned to Pittsburgh, and sent in large flat boats, or keel boats to their destination below, and while the merchant returned on horseback to his home, occupying eight or ten weeks in the whole tour.

Steam Boats and Stages.

The introduction of steam boats and stages has made an entire change in the manner of travelling. The trader now takes a boat, at the landing nearest to his dwelling. At Wheeling or Pittsburgh he seats himself in the stage, and in eight and forty hours, with very little trouble, crosses the mountain ranges, once so formidable to the equestrian; thus accomplishing, in five or six days, a journey from the falls of the Ohio to Philadelphia. His goods now reach the heads of the Ohio, in ten days, and the steam boat, in a very short period, takes them to his home, greatly abridging time, fatigue, and expence. The change has wrought no good for tavern keepers, whatever it may have done for the community.

SOMERSET.

At 1 P. M., we reached Somerset, the capital of Perry County. It is pleasantly seated on elevated ground, and surrounded by a rich agricultural region. It has a neat, brick court house, some good dwelling houses and stores, and about eight hundred inhabitants.

Catholics.

More than one half the population of the town and county are professors of the Roman Catholic religion. They have a substantial brick chapel and nunnery, or school for educating young females. The seminary is in good repute, and many protestant families send their daughters here for that purpose. It is supposed, that in a few years, the whole county will be catholic; as they embrace every opportunity of purchasing the farms and the houses of the protestants, and occupying them with those of their own creed, from other places. A few proselytes are also made, although rarely. The early prejudices of education, and the little intercourse between the protestant and catholic portions of the community, seem to have generated a general desire amongst the former to leave the place, as soon as they conveniently can; thus giving the catholics peaceable, and quiet possession of their hearths, and long cherished homes. It was a wise provision in our constitution which left religion free and every individual in our happy country at liberty to attach himself to that sect which he preferred. So long as this liberty remains, there is little danger of the catholic religion either ruling, or overturning the government.

RUSHVILLE AND RUSH CREEK.—*Geology.*

A few miles west of Somerset, we passed through Rushville, a small village in Fairfield County seated on the high ground east of

Rush creek. This creek is the eastern and main branch of the Big Hockhocking river, about twenty yards in breadth, and has worn itself an immense chasm in the loose loomy earth, one hundred and fifty or two hundred feet below the average height of the adjacent uplands. In its bed is a stratum of limestone, a fact common to many of the streams in the hilly region of Ohio; and sandstone is found near the top of the slope. West of this creek the soil is more argillaceous, and the country, gradually declining, becomes more level, as we leave the hilly portion and approach the great valley of prairies. What is properly called the sandstone formation, terminates westerly, near Lancaster, in Fairfield County, in immense detached mural precipices, like the remains of ancient islands; one of these called mount Pleasant, seated on the borders of a large plain, is nearly four hundred feet high on the S. W. side; affording from its top a fine view of the adjacent country. The base is a mile and a half in circumference, while the apex is only about thirty by one hundred yards, resembling, at a distance, a huge pyramid. These lofty towers of sandstone are like so many monuments, to point out the boundaries of that ancient western Mediterranean, which once covered the present rich prairies of Ohio.

LANCASTER.

We reached Lancaster at 6. P. M. thirty six miles S. Westerly from Zanesville and thirty four miles N. E. from Chilicothe.

May 25.—The weather this morning is cold, with a smart white frost—day cloudy. Lancaster is a flourishing post town; and is the seat of Justice for Fairfield County. It is near the center of the county, in a rich valley, extending several miles on the Hockhocking; surrounded by a widely extended country of excellent lands. It was laid out, or surveyed into lots, in the year 1800, with convenient streets and alleys crossing at right angles. The agricultural population are chiefly of German origin, from Lancaster County Pa. and are an industrious, peaceable, frugal race, following the good old ways of the early Dutch settlers in America. The public buildings are a brick court house, market house, town house, banking house and four or five churches. The private dwellings are chiefly of brick, neat and commodious. The public houses for the entertainment of travellers, are surpassed by few in America, either in size, kind treatment, or good fare. The same may also be said of Zanesville and Chilicothe. Here are two printing offices, which publish weekly, one German and two English newspapers. There are large and well filled stores of merchandise, &c. &c. The present population is about two thousand. The Ohio canal passes within eight miles of the town and the stock has been taken up for opening a lateral cut, estimated to cost $50,000, which will soon be completed. Fairfield County is thirty miles long and twenty four miles broad and contains 25,000 inhabitants.

The Hockhocking.

We left Lancaster at half past seven, crossing a toll bridge over the Hockhocking, which is here a small stream, with a muddy bottom and low banks; we then passed a small prairie west of the bridge, the upper, or surface soil, being black and rich; but the substratum composed of gravel and pebbles, many of the latter are of primitive rocks. It is a compound of primitive, transition and secondary materials, the ruins of former rock formations. The country for the first ten miles west of the Hockhocking, is made up of low hills with fertile valleys between. The hills are composed of argillaceous earth, filled with boulders and pebbles, of primitive and secondary rocks, all of which are rounded and waterworn.

PICKAWAY COUNTY.

We now entered the borders of Pickaway County, turning off westerly into the valley of the Scioto and leaving the "great thorough-fare of the west," on our left. The country from this to Circleville, a distance of eleven miles, is flat, with many wet marshy places of small extent, the soil rather thin, except in the wet spots and pretty well timbered. The boulders, when seen, are of the same character with those passed. Eight miles east of Circleville near the Lancaster road, is a quarry of fine grained sandstone, from which the material used in building the aqueduct across the Scioto, was taken. The texture is compact and beautiful; splitting very readily into blocks of ten, and twenty feet in length, and of any desired width and thickness. The color is a light brown, easily wrought and suffers no decomposition on exposure to the vicissitudes of the weather, a quality not common to all our sandstones. We reached Circleville at 1. P. M.

CIRCLEVILLE—*Ancient Works.*

May 26.—Morning cloudy and rainy, temperature at 5 A. M. 37°. Nimbus at 8 A. M. with thunder, day cloudy, with high winds from W. and N. W. Circleville, situated on the east side of the Scioto river, is a post town, and the seat of Justice, for Pickaway County. It was laid out in the year 1810, and occupies the scite of an ancient city, enclosed by a double circular wall of earth, with a ditch between the walls. From this circular defence it takes its name. The walls were ten feet high, and the ditch of the same depth, making twenty feet from the bottom of the ditch to the top of the walls. The walls and ditch occupy nearly seventy feet, which gives thirty feet as the base of each wall, and ten feet for the width of the ditch. The circular fort or town, was three hundred and fifty yards across. A square fort stands adjoining the circular one, the walls of which were twenty feet, without any ditch. This fort which was three hundred yards across, is an exact square. The present town is laid out on these ancient and venerable works. The court house, built in the form of an octagon, stands in the center of the circular fort; and occupies the spot once covered by a large and beautiful mound, but which was leveled to make room for the building. This forms the nucleus, around which runs a circular street, with a spacious common between the court house and street. On this circular street, the principal stores and taverns are erected, and most of the business is done. Four other streets run out from this circle, like radii from a center. The town contains one thousand five hundred inhabitants, and is gradually increasing. On the S. W. side of the circle stands a conical hill, crowned with an artificial mound. Indeed so much does the whole elevation resemble the work of man, that many have mistaken it for a large mound. A street has lately been opened across the little mound which crowned the hill; and in removing the earth, many skeletons were found in good preservation. A cranium of one of them, was in my possession, and is a noble specimen of the race which once occupied these ancient walls. It has a high forehead, and large and bold features, with all the Phrenological marks of daring and bravery. Poor fellow, he died overwhelmed by numbers; as the fracture of the right parietal bone, by the battle axe, and five large stone arrows sticking in and about his bones, still bear silent, but sure testimony. The elevated ground a little north of the town, across Hargus Creek, which washes the base of the plain of Circleville, appears to have been the common burying ground. Human bones, in great quantities, are found in digging away the gravel for repairing the streets, and for constructing the banks of the canal which runs near the base of the highlands. They were buried in the common earth, without any attempt at tumuli; and occupy so large a space, that only a dense population, and a long period of time, could have furnished such numbers.

On the borders of the Ohio Canal, which passes a short distance west of the town, are built several very large and substantial brick ware houses. The base of one side stands in the water, so that boats deliver and receive their cargoes, with very little trouble.

Scioto River—Aqueduct.

The canal crosses the Scioto river, a little below the center of the town, by means of an aqueduct, supported by two abutments and four piers; built in the most substantial manner, of a very fine grained and beautiful sandstone, mentioned in the diary of yesterday. It was a Herculean task, to haul these stones, eight miles in wagons and carts, over a muddy road. The masonry is based on oaken piles, driven eighteen or twenty feet into the bed of the river. The piers are forty feet in height, and every stone being cut to a certain thickness, (about fifteen inches), and laid in strong cement, make a beautiful appearance. They are also forty feet in depth, and ten feet in thickness, rounded on the upper, or side presented to the current, and finished in such a way as to resemble vast pillars, crowned with their capitals. The aqueduct is a wooden trunk, four hundred and forty eight feet in length. The reaches of the trunk between the piers, are supported by wooden arches, of eighty feet span. A lock with a fall of nine feet, built of the same beautiful material, is connected with the abutment on the west side of the aqueduct. The canal is now open from Chilicothe to Lake Erie, and boats pass daily. The Scioto river is here, one hundred and fifty yards wide, and is a handsome rapid stream.

Soil and Agriculture.

The bottom lands are low and subject to occasional floodings, but are of a very rich soil. Pickaway county is nearly square in outline, being twenty-two by twenty-one miles in extent, and contains sixteen thousand inhabitants. The Scioto river passes through it from N. to S. dividing it into two nearly equal portions. The lands on the east side are of a very excellent quality and produce all the different kinds of grain in the most luxuriant abundance. The county, contains four varieties of soils, wood lands, barrens, plains and prairies. On suitable soils, from forty to forty-five bushels of wheat are produced, and in early days, before the rich prairies were reduced by successive crops, one hundred bushels of corn per acre, were not uncommon. By the rich farmers, cultivation is carried on in a style and grandeur proportionate to the exuberance of the crops. Fields of one hundred acres of wheat, or of corn, are often seen, and frequently they are extended to three or four hundred. A few years since when wheat commanded a dollar per bushel, a rich farmer on the Pickaway plains, cultivated one thousand acres in a single field, which when undulating under a gentle breeze, might not unaptly be called an ocean of verdure. In all the counties bordering on the canal, there has since it was opened, been an increase in the value of wheat of from ten to fifteen cents per bushel, and so of many other articles; the canal giving them the advantage of the New York markets, whereas before, they had only that of the Mississippi.

Canals.

For so young a state, Ohio may be considered one of the most enterprising of the united family. Her canals cover an extent of four hundred miles, and have been constructed at an expense of more than five millions of dollars. The main canal stretching from Lake Erie to the Ohio river, passes through some of the most fertile portions of the State, and completes the line of water communication between the Hudson and the Mississippi. It is three hundred and eight miles in length, forming a strong link in that chain of turnpikes and canals, which, like so many ligaments serve to bind together this fair republic, composed of such repulsive materials. The Miami Canal, between Dayton and Cincinnati, is sixty-six miles in length. The remainder is made up of side cuts and feeders.

The following extracts, taken from the very able and interesting report of the canal commissioners, made in the winter of 1833, will give a view of its route, and the region through which it passes.

"The Ohio Canal, at its northern extremity, terminates in the Cuyahoga River, on the east side, about half a mile from the junction of that river with Lake Erie, and at the south westerly corner of the village of Cleveland. That section of the river which extends from its mouth to the bridge, about three hundred yards above the termination of the canal, forms the harbor, into which schooners, sloops and steam-boats enter from the lake, to discharge and receive their cargoes from warehouses, or meet with canal boats for the mutual exchange of their lading. The average breadth of the river is here about one hundred yards; its depth from twelve to twenty feet. It opens into the lake by a safe and straight channel, in no place less than ten feet in depth. This channel is secured from the deposition of moveable sand by two parallel piers, about one hundred and eighty feet apart, extending from the shore, on each side of the river, one thousand two hundred feet into the lake. These works were erected by the United States, and completely answer the contemplated purpose, forming one of the most safe and commodious harbors on the lake, accessible in any state of the wind or weather. A small light-house, on the extremity of the eastern pier, enables vessels to enter the harbor with safety during the night. These structures do credit to the enlightened policy of our government, and to the fidelity and skill of the officers and engineers by whom the work was executed. Two locks, each of six feet lift, the chambers of which are twenty five feet wide and one hundred feet long, having eight feet depth of water on the mitre sills, connect the canal with the river, and admit the largest class of sloops and schooners which navigate the lake, to pass from the river into a basin, of nearly a quarter of a mile in length, with a medium breadth of one hundred and twenty feet, and a depth of eight feet. The dry docks are so constructed, as freely to admit lake vessels and canal boats to pass into them from this basin, for the purpose of receiving repairs. The economy, expedition, and safety with which these repairs are thus made, greatly encourage and facilitate the commercial operations connected with canal navigation. From this basin, the canal ascends the valley of the Cuyahoga, on the eastern side of the river, twenty four miles to the Peninsula, where it crosses to the western side; thence along the western side of the river ten miles, after which it leaves the valley of the main river, and ascending that of the Little Cuyahoga and the outlet of the summit lake four miles, it reaches the north end of the Portage summit level at Akron, thirty eight miles from Cleveland. On this division, there are forty four locks, overcoming a total ascent of three hundred and ninety five and a half feet, twenty one of which are within three miles, and sixteen within a mile and a half of the north end of the summit level."

"The length of the Portage summit level of the canal is about nine miles. Its elevation is three hundred and ninety five feet above the surface of Lake Erie, four hundred and ninety one feet above the level of low water in the Ohio at Portsmouth, seventy eight feet higher than the Licking summit, and nine hundred and fifty nine feet above tide water in the Hudson River at Albany. Connected with this level are three small lakes, comprising an aggregate area of three hundred and fifty acres. These lakes form a natural reservoir, which prevents a sudden rise of the water in the level, from the occurrence of rains and swelling of the streams which flow into it, while the great expanse of the surface will furnish a large amount of water to meet any extraordinary demand which may be occasioned by accidental causes, or a press of business on the canal, without diminishing materially the depth. One of these lakes, called the summit lake, near three fourths of a mile in length, forms part of the canal. The towing path across it is constructed partly on floating bridges, made of light timber, dowelled together, so as to form a perfect floor, secured in their proper positions by means of long piles driven into the bottom of the lake, and rising above its surface, and partly by throwing up a bank along a projecting part of the shore between the bridges. The depth of the water, and the marshy character of the shore and the bottom, prevented the formation of a tow path of earth along those parts of the lake where the bridges are used. The waters of this lake were formerly discharged northwardly through a small outlet into the Little Cuyahoga, and thence into the main river. A swamp extended from the head of the lake to the main branch of the Muskingum, here called the Tuscarawas, the highest part of which, on the line of the canal, was about four feet above the surface of the lake. In order to obtain the full volume of the Tuscarawas, in dry seasons, as a feeder to the summit level, that level, and consequently the surface of the lake, were reduced about five feet below its original elevation. This little lake, situated on the summit, between the waters of the St. Lawrence and the Mississippi, elevated nearly a thousand feet above the ocean, and skirted on its western side by a range of hills, rising one hundred and fifty feet higher, is an interesting feature in the formation of the country, which, in the vicinity of this summit, seems to be peculiarly well fitted for the passage of a canal, and for furnishing it with a constant supply of water. The main branch of the Muskingum, here a small river, but remarkable for the uniform quantity of water flowing in it at all seasons of the year, being never less than one thousand eight hundred cubic feet per minute, furnishes the principal supply of water to this summit."

"From the south end of the Portage summit level, the canal descends along the valley of the Muskingum, one hundred and two miles, to Websport, which is situated near the mouth of the Wakatomaka Creek, a small westerly branch of that river, one hundred and forty nine miles from Cleveland. This place is on the lowest level between the Portage and the Licking summits, from both of which there is an uninterrupted descent to this point. Proceeding from the Portage summit, southwardly, the canal occupies the west side of the river to Clinton, six miles; crossing here by means of a dam, it occupies the east or left side of the river, twenty eight miles, to a point about three miles above the mouth of Sandy Creek. Here it recrosses to the right bank on an aqueduct, called the "Tuscarawas aqueduct," and continuing thence on the west side, it crosses the Walhouding River, about half a mile from its junction with the Muskingum, on an aqueduct, and proceeds thence on the same side to Websport."

"The total descent from the Portage summit to the low level at Websport, is two hundred and thirty eight and a half feet, and is effected by means of twenty nine locks, in a distance of one hundred and nine miles from the summit lake."*

"In proceeding from the low level towards the Ohio, the canal leaves the immediate valley of the Muskingum, and pursuing a south westerly direction, it ascends the valley of the Wakatomaka about nine miles, and passing through a gap in the range of hills which separates this valley from that of the Licking, it enters and ascends the valley of that stream, to Newark, in Licking County; thence continuing along the valley of the south fork of the same stream, it reaches the Licking summit, one hundred and ninety one miles from Lake Erie."

"The Licking summit is the highest ground over which the canal passes between the valleys of the Muskingum and the Scioto rivers; but the canal here occupies the point of greatest depression in the dividing ridge, or rather *table land*, which separates the two valleys. The total ascent in the canal, from the low level at Websport to the Licking summit, is one hundred and sixty feet, which is overcome by means of nineteen locks, and the distance is forty two miles. The elevation of the Licking summit level is three hundred and

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* The descent from the Dresden or Websport level to low water mark in the Ohio, at the mouth of the Muskingum, is one hundred and fifty four and a half feet; from which it appears that the surface of low water in the Ohio, at the mouth of the Muskingum, is two feet higher than the surface of Lake Erie.

seventeen feet above the level of Lake Erie; four hundred and thirteen feet above the level of low water in the Ohio at Portsmouth, eight hundred and eighty one feet above the level of tide water in Hudson, and seventy eight feet below the level of the Portage summit." "Immediately north of the ridge which here divides the waters of the Muskingum from those of the Scioto, is situated the great *Reservoir*, from which the summit level and the lower levels of the canal, extending to Newark in one direction, and to the junction of the main line with the Columbus feeder in the other, during the dry season, derive their principal supply of water. This reservoir extends from west to east nearly eight miles. Its medium breadth is about half a mile, covering, when the surface is six feet above top water line in the canal, an area of nearly two thousand five hundred acres. It is capable of furnishing the summit level, and the other levels dependent upon it, with water for a period of three months, without any aid from streams; and the water of occasional summer rains, which flows into it through various channels from the surrounding country, greatly increases its capacity for supplying the canal. This great reservoir occupies a natural basin, the bottom of which is a tenacious soil, composed principally of clay. This basin was surrounded by higher ground, except on the north west side, where it was low and flat. A large portion of its area was originally occupied by a chain of small lakes and an extensive marsh. In order to confine the water in this basin, an artificial bank of about four miles in length, two of which also form the towing path bank of the canal, was raised across the low ground on the north west side; and the waters of the south fork, taken from the stream several miles above, are conducted by a feeder of about six miles in length, on a higher level, into the reservoir, near the south west end of which the feeder passes over the canal, on an aqueduct, and falls into the reservoir."

"In order to insure an adequate supply of water to the summit, it was necessary to cut down the ridge, which here divides the waters of the Scioto, from those of the Muskingum, so low as to permit the water of the reservoir to be drawn into the summit level of the canal. This required a deep cut of near three miles in length, commencing near the feeder aqueduct, one hundred and ninety miles from Cleveland and extending thence southwardly. The deepest part of this cut near the centre is about thirty four feet, gradually diminishing in depth towards each end. The quantity of earth excavated amounts to near a million of cubic yards, and is composed of blue clay and sand, in which small pebbles of stone were firmly imbedded. The cut through the ridge at this summit, presents the most formidable obstacle encountered at any one point on the canal." "From the Licking summit the canal descends southwardly along the valley of Walnut Creek, (a branch of the Scioto), which it crosses from the right to the left bank, ten miles from the summit, on a culvert of fifty feet chord. At Carrol, two hundred and four miles from Cleveland, the Lancaster lateral canal, unites with the main trunk. Three miles below, the canal crosses to the right bank of Walnut, and gradually receding from that stream, it passes over a remarkably level tract of country, which separates Walnut from Big Belly Creek, when it descends into the valley of that stream, about two miles above its junction with the Scioto, and receives the Columbus feeder at Lockbarne. Between the Licking summit and the junction, the canal descends two hundred and two feet and four inches, by means of thirty locks. From the point where the Columbus feeder joins the main canal, the canal pursues a southerly course along the valley of the Scioto to the Ohio river; crossing the Scioto, at Circleville, two hundred and thirty six miles from Cleveland, it continues on its western side to its junction with the Ohio at Portsmouth." "The total descent from Lockbarne, to low water in the Ohio, is two hundred and eleven feet, which is effected by means of twenty four locks in a distance of eighty seven miles. The level of low water in the Ohio, at the termination of the canal is four hundred and thirteen feet lower than that of the Licking summit—four hundred and ninety one lower than the Portage summit—ninety six lower than the level of Lake Erie, ninety eight lower than the level of low water at the mouth of the Muskingum and four hundred and sixty eight above the level of the ocean." "The main trunks of the Ohio and Miami canals have each a minimum breadth of forty feet at the water line, and twenty six feet at bottom with four feet depth of water—a large proportion of both, particularly the Ohio canal, is of much larger dimensions, having a breadth at the water line varying from sixty to one hundred and fifty feet, and a depth of from five to twelve feet. In many places it even exceeds these dimensions both in breadth and depth. The walls of the locks are of solid stone masonry with faces of cut stone, laid in regular range work, and the whole wall grouted with lime mortar. The stone culverts are composed of arches, cut in regular segments, and laid in range work, with wing and parapet walls of cut stone. The lift locks on the Canals amount to one hundred and eighty four, overcoming a total amount of ascent and descent of one thousand five hundred and forty seven feet—eight guard locks—twenty two aqueducts—two hundred and forty two culverts one hundred and eighty two of which are of stone masonry and sixty of wood—nine dams for crossing streams and twelve feeder dams."

Worship.

May 27.—Morning clear and cool; Ther. 43°, day fair. This day being the Sabbath, was taken up in attending the Presbyterian Church, and refreshing our minds and bodies with rest. The house was well filled, with a neatly dressed devout and serious audience. The desk was supplied by a Baptist preacher from Cincinnati, who was attending a conference of his brethren at Old-town, about ten miles south westerly from Circleville, and formerly the seat of old Chilicothe, a large and noted Indian village belonging to a branch of the Shawoenee tribe. This town embraces the usual variety of religious sects found in the west, and a society of the Dutch reformed, who are numerous in this county, and have recently with ceremonies common on such occasions laid the foundations of a stone building for the use of their church. The sabbath is strictly observed here; which is one of the strongest proofs of a moral and religious community.

Country to WILLIAMSPORT.

May 28.—Morning fair. Ther. at 45° day fair, cumuli and cum. strati, at 8, A. M. we crossed the Scioto, at the ferry near the aqueduct, on our way to Williamsport, a small village nine miles west of Circleville, on Deer Creek. The road passes near the canal for half a mile on the low bottom lands, it then rises a little on to the second bottom, which is a mile in width. The soil is very rich, black and loose; from three, to six feet in depth, based on a substratum of gravel and water worn pebbles. After leaving the bottom lands the country rises considerably and is lightly undulating for three miles, when we reach a tract of country denominated "the great Barrens." This tract is about fifty miles in width and nearly one hundred in length from N. to S. indeed it is said the same formation extends to the "Black Swamp" at the head of Sandusky Bay. The land is level, with occasional wet places fit only for grass; while other spots produce corn and grain; by drainage the whole might be brought into cultivation. The soil is generally argillaceous, with a thin growth of forest trees, chiefly pin oak, post oak, black jack and aspen; but on the western border, many trees of the Gymnoclydus canadensis, or Kentucky coffee tree, and Quercus macrocarpa are found in addition to these—many wet swampy places are destitute of trees. From the direction of the water courses which head in this singular tract, and run along its sides, as is the case with Darley Creek along its eastern border, I am led to conclude that the "Barrens" is a more elevated region than the adjacent country. The soil is admirably adapted to the growth of grass, rising to the height of four or six feet; the whole region may be denominated a natural meadow. Vast herds of cattle are pastured in the summer and fed through the winter on hay cut and put up in stacks; a few years ago regular herdsmen attended them through the season like the patriarchs of old; but latterly vast fields of several thousand acres have been enclosed with fence and the cattle confined within them.

The Barrens—Lime water.

"The Barrens" also abound in wild flowering plants through the summer and autumn, resembling in beauty and variety an immense garden. The most common and abundant belong to the families of the Heleunis, Solidago, Rudbeckia, Aster, &c. In penetrating the earth for wells, water is usually found at the depth of ten or twenty feet. It is highly impregnated with lime; so much so as to coat over the outsides of the buckets, and the ends of the poles, for they here use the primitive fashion of "pole and sweep," with lime, which at first I mistook for a coat of white wash. To render it fit for the washerwoman's use "it is broke," as they call it, with a lixivium of wood ashes; thus neutralising the carbonic acid and rendering it soft.* Sometimes wells are sunk to the depth of thirty or thirty five feet before water is found; and in those spots two or more beds of gravel are passed, alternating with beds of clay of four or five feet in thickness. In wet seasons the water rises to near the surface of the wells. It is considerably cathartic to those unaccustomed to its use.

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* Occasioning of course, as we presume a precipitate of calcareous carbonate, we should like to know whether muriate of lime is not also, found in the water of limestone countries.—*Ed.*

Mineral Spring—Slate or Shale—Shells.

At West-Port, which is a small village of ten or fifteen houses, two stores and a mill, is a fine mineral spring, rising in the bed of Deer Creek. The water contains sulphate of magnesia, iron, and carbonic acid gas, causing the water to sparkle briskly as it runs from the earth. The spring rises from a vast bed of recent clay slate, which for many miles forms the bed of the creek, and a cliff along its banks of twenty feet in height. The slate contains iron pyrites, and fossil impressions of bituminized wood. The spring is copious, and moderately cathartic, affording probably a barrel of water in two minutes; and when confined in a tube of boards rising to the height of eighteen feet and running over the top. Deer Creek affords some of the most beautiful specimens of shells of the Genus Unio, that I have seen in Ohio. But in the summer months, the waters of the creek become so much charged with lime, as to coat entirely over the outside of the shells an eighth of an inch in thickness.

This deposit of clay slate is probably very extensive, as the same is found on the Whetstone fork of the Scioto, north of Columbus; on Paint Creek in Ross County, and on the eastern branches of Brush Creek in Adams County, a distance of one hundred miles.

Iron Ore.

I am led to call this deposit iron ore from the fact of its containing globular pyrites, and some specimens approaching to clay iron ore, or carb. of iron, which are melted up with other ores in the furnaces in Newark and Granville, where they are found out of place, in the diluvial earth, amidst boulders of limestone and primitive rocks at ten or twelve feet below the surface. The furnace men and ore diggers, fully believe them to be cannon balls and bomb shells, used by the ancient inhabitants in defence of their forts, which near Newark are numerous and extensive. When found in place they are of all sizes; from one inch, to ten feet in diameter, some of them are perfect spheres; others are oblate at one pole, or urn-shaped. So exact is the resemblance to a globular iron casting, with a ring in relievo all around the margin, that it is hard to divest one of the belief of their artificial origin. I have several in my cabinet, both urn-shaped and spherical. In the banks and bed of Deer Creek, I saw a number in place, at least eight feet in diameter; when long exposed to the atmosphere, they had split into numerous fragments, probably from the action of oxygen on the iron.* On the eastern branches of Brush Creek the country is hilly and broken; and as the slate decomposes, these globes of pyrites tumble out and roll to the bottom of the hills where they can be picked up of all sizes. Considerable quantities of native alum and copperas are found in the crevices of the slate and are used by the neighboring inhabitants in coloring their domestic cloths. In the same neighborhood are found in great abundance, both clay and bog iron ore, and the latter is extensively manufactured into pigs and castings—a few miles east of Brush Creek, above the mouth of the Scioto, large beds of iron ore are found, lying over limestone, containing immense quantities of fossil shells imbeded in the ore; embracing many distinct species of Pecten, Productus, &c. with chambered univalves--some of them are finely preserved shewing the most minute workings and the hinge margin having some resemblance to the head and beaks of a bird; the country people call them "Paroquets petrified." We returned to Circleville in the evening, after a day spent very pleasantly.

TO CHILICOTHE.—*Canal Boats.*

May 29.—Morning cool—Ther. 45° day fine. Rose at an early hour and went on board a canal boat, in company with a number of ladies and gentlemen on a trip to Chilicothe. The boat moved at the rate of four miles per hour, by the aid of two horses, which were changed but once in the distance of twenty three miles. These boats are fitted up with great neatness, and afford every necessary comfort to the traveller. The canal passes along back of the Scioto bottom, near the base of the uplands, which here as well as all over the Scioto valley are composed of gravel, clay, and water worn pebbles and

* A part of the summer of the year 1830, was excessively dry in the S. W. portion of Ohio. Scioto Brush Creek, is a small western branch emptying its waters into the Scioto river a few miles above Portsmouth. It heads in the same slaty hills with some of the branches of Adams County Brush Creek. During the drought the water all disappeared from the creek, leaving its bed entirely dry for several weeks. Towards the close of this period, loud and frequent explosions took place from the slate at the bottom of the creek, throwing up large fragments of the rock and shaking the earth violently for some distance. The inhabitants living near its borders became much alarmed, thinking a volcano was breaking out. On examining the spot, large pieces of iron pyrites were found mixed with the slate stone. The water, which had heretofore protected the pyrites from the atmosphere, being all evaporated, the oxygen found its way through the crevices of the slate to these beds, and acting chemically upon them, new combinations took place, forcing up the superincumbent strata with great violence and noise—when the water again covered the bed of the creek, the explosions ceased. I have one or two large fragments of the pyrites, given me by an intelligent friend who visited the spot at the time.

boulders of primitive formations deeply covered with a rich coat of vegetable soil; a substantial dam of stone crosses the river a mile below the aqueduct, and furnishes water to a main feeder for the canal. Five miles below, the canal passes along under the edge of the "Scioto Bluffs;" which are high banks of gravel, belonging to the uplands, and occasioned by the undermining of the river in its migrations from one side of the valley to the other. They are from fifty to one hundred feet high, and extend for two and a half miles along the river. The bottom and bank of the canal next the river are formed of this gravel, while the Bluffs themselves make the other bank of the canal. The Scioto washes the foot of the bank on one side, and when high, becomes very turbulent and angry at the encroachments made on its territories; while on the other, the Bluffs are occasionally slipping down and filling up the canal, occasioning not a little trouble and vexation to the managers of the work, a few years will probably regulate the work, and the whole will become solid. We passed eight locks between Circleville and Chilicothe, which are all built in a neat substantial manner; many of the top or coping stones being ten or twelve feet long, four wide and a foot thick. We reached C. at 9, A. M.

CHILICOTHE.

This town is the seat of justice for Ross County, and was for many years also the seat of government for the state. It contains about 3000 inhabitants, and the whole county 25,000. It derives its name from that of a celebrated Indian town, seated on the waters of Paint Creek, twelve miles N. W. of this, and which was probably the largest of the kind in Ohio. Chilicothe has increased rapidly since the location of the canal; which passes directly through one of the principal streets near the river. Many substantial warehouses are built along its borders, and a large amount of business is transacted. "It is seated on a level alluvial plain, about forty feet above low water in the river, and bordering a fertile tract of about 10,000 acres." "The Scioto washes the northern limit of the town, while Paint Creek winds along its southern verge; the two streams being here about three fourths of a mile apart." The principal streets run parallel with the course of the river and are crossed at right angles by others, extending from the river to Paint Creek. The main streets cross each other at the centre of the town and are ninety nine feet wide. Water street, which fronts the river, and along which the canal passes, is eighty two feet wide; all the others are sixty six feet.

It was first laid off in 1796. "It has two printing offices with weekly papers, numerous mercantile stores and several flouring mills in and about the town; amongst the public buildings are a neat and beautifully constructed Bank building; a new market House, with handsome cut stone columns in front, surmounted by a cupola and bell; a Court house; several meeting houses, and an academy for young females. Two of the Hotels are hardly surpassed by any in America, either in size, elegance, or sumptuous entertainment. From the summit of a hill, (the first of which appears, as you descend the river, near this place) rising very abruptly on the west side of the Scioto, to the height of three hundred feet, you have a most delightful view of the town and surrounding country interspersed, with woods and verdant lawns, amongst which the Scioto river meanders its silent way to the Ohio." Its course from this place, a distance of seventy miles, is southerly, through a hilly country.

A fair.

While in C. we attended a very interesting Exhibition and Fair, got up by the ladies, who as is usual in other places are here celebrated for their zeal and activity in useful and charitable objects. The fair presented a great variety of fancy articles, executed, in the neatest manner, by the ladies of the place, intermixed with natural flowers, and arranged in the most tasteful order on tables around a large hall; several hundred dollars were realized from the sale and devoted to the purchase of an organ for the Episcopal church. We left Chilicothe at 3. P. M. crossing the Scioto on a well constructed bridge, and returning by land on the east side of the river. After crossing the bottom we gradually ascended the upland plains, here about one hundred feet above the bed of the river, leaving the hill region on our right, but still in sight of the road for several miles.

A Tale.

While passing over this tract, a very interesting border tale, narrated to me by a gentleman for several years personally acquainted with the actor, was vividly recalled to my mind from the fact that the theatre of the story was not far from this spot. Joshua Fleehart, was born and brought up in the frontier settlement of Western Pennsylvania, in the days of her border warfare. He was as much a child of the forest as any of its copper colored tenants; his whole life, from boyhood to thirty years of age, having been spent in hunting bears, deer, buffaloe, and occasionally Indians. He was also an experienced trapper; and knew how, with astonishing tact, to counteract and overcome the cautious cunning of the half reasoning Beaver; never failing, when once in their neighborhood, of securing them in his traps. His person had been formed after one of natures largest and most perfect models; being several inches over six feet in height, with limbs of uncommon muscular size and strength. His face was broad with high cheek bones, terminating in a projecting chin, indicative of great firmness of purpose and natural bravery. A light hunters cap covered his head, affording a slight protection to his small keen eyes, which always shone with uncommon lustre at the approach of danger. He could neither read nor write: but as his mental faculties had been uncultivated, his outward senses became doubly acute and active. His usual dress was in the true backwoods style; consisting of mocasins, buckskin leggins reaching above the knees, and fastened to a garment around the loins, a coarse woollen hunting shirt covered his arms and body, the skirts reaching to the tops of the leggins, and fastened around him by a broad leathern belt, to which was suspended a hunting knife and tomahawk: while a capacious powder horn and bullet-pouch, hung by a strap from the opposite shoulder. The rifle he was accustomed to use was of the largest caliber; and of such a thickness and length that few men were able to raise it to the eye with a steady hand.

His four brothers were all of the same gigantic mould, one or two of whom were employed as rangers, by the Ohio Company during the Indian war. Two sisters were also more than six feet in height. When the colonists from New England, took possession of the country about Marietta, Fleehart resided with his wife and family of young children on an island in the Ohio river, near Belpre; since become classic ground as the scene of Aaron Burr's conspiracy, and the abode of Blennerhasset, so touchingly described by the pathetic eloquence of William Wirt. After the war broke out in 1791, he removed them into "Farmer's Castle," a strong stockaded garrison opposite to the island, and resided there himself; but in the most dangerous times he would hunt fearlessly, and alone, in the adjoining forests; and whenever there was an alarm given by the rangers, who constantly scoured the woods, and the other tenants of the "castle" were seen hurrying from their cornfields within its protecting walls, Fleehart would almost invariably shoulder his rifle and take to the adjacent woods, like honest Leatherstocking in the "Last of the Mohegans;" giving as a reason that he could do more service there in case of an actual attack; and also feeling himself more free and courageous when behind a tree and fighting in the Indian manner, depending on his own personal activity, than when cooped up in a garrison. During the Indian war in 1794, being tired of confinement, he determined to have a hunt by himself, and again breathe freely in the forests. Knowing from long experience that the Indians, almost invariably, confine themselves to the vicinity of their towns during the winter months, he pushed immediately for their best hunting grounds. Taking his canoe, rifle, traps, &c. he late in November ascended the Scioto river, to near the spot where the town of Chilicothe now stands; being ten or fifteen miles from the then Indian Chilicothe. Here he built himself a bark hut, and spent the winter with all that peculiar enjoyment which is known only to the breast of "a backwoods hunter." He had been very successful in the chase, and had loaded his canoe with the hams of the Bear, the Elk and the Deer; to which he had added numerous, packages of their skins, with those of the more valued Beaver—with all the precaution of an experienced warrior in an enemies country, he had securely fastened his well laden canoe, several miles below, behind the willows which then bordered the shores of the Scioto. The melting of the snow, the swelling buds of the sugar tree, and above all the flight of the wild geese on their annual northern tour reminded him that it was time to depart. He had cooked his last meal in his solitary hut, and was sitting on a fallen tree in front of it, examining the priming and lock of his rifle; the sun had just risen, when looking up the bottom, he saw a large Indian examining with minute attention the tracks of his mockasins, made as he returned in the evening to his camp. While hunting in the direction of the Indian town, the day before, his acute and practised ear had distinguished the report of an Indian rifle at a remote distance. Fleehart immediately stepped behind a tree, and waited until the Indian had approached within the sure range of his shot. He then fired, and the Indian with a yell and a bound, fell to the earth. The scalping knife had commenced its operation, but as he was not quite dead, he desisted, and fell to cutting loose some of the silver bands with which his arms were profusely ornamented,* and tucked them into the folds of his

* In excavating the Ohio canal not far from the scene of Fleehart's adventure, the skeleton of an Indian was found with several broad silver bands on the bones of his arms. Two of them are now in my collection of antiquities. They appear to be of French manufacture, as one of them is ornamented with the "Fleur de lis" engraved on its front. They are about three inches wide and six long, with perforations at the end, for thongs to confine them on the arms. They weigh two and a half ounces—as Fleehart striped off only a part of the bands, it is more than probable that this was the identical Indian.

hunting shirt. While thus busily occupied he looked up, and saw four or five Indians close upon him. This being too numerous a party for him to encounter alone he seized his rifle and took to his heels. They fired upon him but without effect; he soon left them all far behind but two, who being more swift of foot than their companions continued the chase for four or five miles, without his being able to leave them—he often stopped and "treed," hoping to get a shot and disable one of them and then kill the other at his leisure; as soon as he took a tree the Indians did the same, and by flanking to right and left, soon forced him to uncover or stand the chance of a shot. In this dilemna he concluded to try the hills, and leave the level ground on which they had so long been struggling. His vast muscular power here gave him the advantage as he could ascend the steep side of the hill more rapidly than his lighter but less muscular foes. Perceiving him to be leaving them, the Indians stopped and fired; one ball passed so near as to cut away the handle of his hunting knife as it hung at his side, jerking the blade so violently against it as to make him think for a moment that he was wounded. He immediately returned the shot, when the Indians with a tremendous yell abandoned the chase. Fleehart, a little out of wind, made a wide circuit in the hills, and came into the river near to where he had fastened his canoe; finding all safe, he lightly jumped on board and pushed vigorously through the day; at night he laid down in his canoe and when he awoke in the morning, was just entering the river Ohio; crossing over to the southern shore, he coasted along its calm waters, and reached "Farmer's Castle" in safety, laden with the spoils of his foes, and gratified with the admiration of his old companions. After the peace, as the tide of emigration rolled westward, Fleehart still kept on the borders, and was finally killed in some petty quarrels with his natural foes, the red men of the forest.

PICKAWAY PLAINS.

At about four miles from the Scioto we stopped for a draught of water, and on enquiring the depth of the well found it to be one hundred feet; the greater part of the distance through a bed of sand, ending in coarse gravel. Three and a half miles south of Circleville we crossed the celebrared Pickaway plains, said to contain the richest body of land in Ohio; and notwithstanding their elevation, the inhabitants, like those of the Champagna de Romani, have ever been sadly troubled by "Malaria," during the autumnal months. They are divided into two parts, the greater or upper plains, and the lesser or lower one. The soil was very black when first cultivated; the result of vegetable decomposition through a long succession of ages. These plains are based on water worn gravel and pebbles. The upper plain is at least one hundred and fifty feet above the bed of the river, which passes about a mile west of them. Their form is elliptical, with the longest diameter from N. E. to S. W. being about seven miles, by three and a half or four miles. They were destitute of trees when first visited by the whites, excepting a few on the eastern border. The fertility was such as to produce one hundred bushels of corn, or fifty of wheat to the acre, for many years; but they are now less productive.

TO SOUTH BLOOMFIED.—*Prairies.*

May 30.—Day warm and pleasant—cirri—mean temperature about 65° made a short excursion to South Bloomfield, a small village nine miles north of C. on the road to Columbus. It is seated in the midst of one of those rich plains or prairies, common in the Scioto valley. The soil is loose and dark colored, on a gravel or diluvial substratum, composed of limestone and primitive fragments In digging for wells, a fine sand is found under the gravel, at ten or fifteen feet; and in this stratum of sand, excellent water at twenty or twenty-five feet.

Teeth of the Elephant and Mastodon.

The Ohio canal passes about a mile east of Bloomfield. In excavating the earth to lay the foundation of a culvert, in a small branch near this place, several teeth and rib bones of the Mastodon were found. The teeth were in a fine state of preservation, imbedded in a black boggy earth, such as accompanies the peat formation, which is said to be common in the low wet grounds of this vicinity—a part of the teeth belonged to the ancient American Elephant; one of the latter is now in my cabinet. It is the last of the molares; seven inches broad, six long, and three inches thick, and weighs five pounds. The plates of ivory which compose the main body of the tooth, and are united, or cemented by calcareous matter, run from the root to the crown, and terminate on the grinding surface in grooved lines or furrows. Ridges of the same width, with depressions between, run down the sides of the tooth to the alveolar portion, or roots, giving it a grooved appearance. The enamel is perfect, and looks as if it had been coated with black varnish. I have one other but smaller tooth of the same race or species, found in the gravelly diluvium, back of Circleville. It is quite perfect, but coated with lime. The teeth of the mastodon were very black and highly splendent over the enamel—the grinding surface trenchant and cut into deep depressions, like those of a carnivorous animal.

Face of the Country.—Cattle.

The country between C. and Bloomfield is undulating; soil rich, affording the finest kind of land for cultivation. The crops of grain and clover look very luxuriant. Many of the farmers here get their winter stock of hay from the "Barrens" west of the Scioto, where Red top grass (Agrostis vulgaris, S.) grows in the greatest abundance without the aid of man. Large tracts are enclosed with fence for mowing and for pasturage. Mr. Gwinn on Darby creek, in Madison County, has a farm of four or five thousand acres, enclosed and divided into large fields, sufficient for the support of 1200 head of cattle, which is the number of his present stock. Many others in the cattle business have herds of from two to eight hundred, and lands in proportion. These cattle are many of them collected from the states west of Ohio, and when fattened are sent to the eastern cities. But little grain is raised in "the Barrens," which extend from the Scioto to the heads of the Miamies, and yet they are singularly adapted to the pursuits of men like those of the Patriarchs of old, "whose wealth consisted in cattle."

Conclusion.—Plants.—Shells.—Pearls.

May 31.—Day fine, warm and pleasant; mean temp. 66°. This being the last day of our excursion, it was spent in examining the environs of Circleville, for botanical specimens; and the shores of the Scioto, for shells. Some fine species of univalves were found, but no new ones of the Uniones. Some of our fresh water shells produce very fine pearls. I have one taken in the waters of the Muskingum, from the shell known as the Unio nodosus of Barnes. It is a thick tuberculated shell, with the most rich and pearly nacre of any in the western rivers. The specimen is perfect in form, being plano-convex on one side, and a full hemisphere on the opposite. It is nearly half an inch in diameter across the plane face, and three eighths of an inch through the transverse diameter, and of a very rich, pearly lustre. Set in a gold watch key, and surrounded by facets of jet it makes a beautiful appearance; and is by far the largest and finest pearl I have ever seen. Several others have been found, but none to be compared with this. Pallas, in his travels through the southern province of the empire of Russia, states, that pearls are often found in the fluviatile shells of that region.

Art. II.—*Report of the Regents of the University, to the Legislature of the State of New York, Feb.* 28, 1833.

Through the kindness of the venerable chancellor of the Regents, Simeon De Witt, Esq., we have again been favored with this valuable annual document.

The object of the Regents, the improvement and elevation of the academies of the State, and the measures used to accomplish it, are alike honorable to the legislature that provides the means, and to the gentlemen who are charged with their application.

The academies more particularly engage the attention of the board, as any of them may receive an appropriation from the literary fund, on complying with certain requisitions. They are required to make meteorological observations, and forward a copy annually to the chancellor; and each successive report has evinced the zeal of the instructors in forwarding the views of the regents. The report of the last year, is far in advance of any previous one, and presents a series of meteorological observations and facts, which may be regarded as elements of future calculations. The academies furnish teachers to the lesser or common schools, and also prepare the students of the colleges; and the character of the academies has a direct and decisive influence, not only upon each other, but upon all the schools and seminaries of learning in the State. The adoption of the system of registering scientific observations, by the literary institutions of every State of the Union, and the annual publication of these reports, for the information of men of science, and as an incentive to legislative bodies, we hope may contribute to diffuse scientific intelligence, and to promote both the physical and intellectual interests of our country.

Want of room prevents our giving extensive extracts from the last annual report from New York, but we will endeavor to give a general sketch.

The returns from the university and the colleges of the State, report 600 students; of the medical schools, 379;—65 academies, which received ten thousand dollars of public money, reported 4856 students—showing an increase over the number in a previous report, of 668.

The regents have particularly recommended to the academies the "preparation of teachers," as a subject of the first importance; accordingly in several academies, there are lectures upon the principles of teaching, and two academies last year furnished seventy teachers, who are now, we trust, fountains of knowledge to large circles of pupils.

The first "Abstract" shows the course of studies pursued at the different academies—besides Arithmetic, English Grammar, Geography and Latin and Greek, we find Book-keeping, Biblical and Roman Antiquities, Constitutions of New York and the United States, Criticism, Rhetoric, Logic, Intellectual and Moral Philosophy, Evidences of Christianity, Natural Theology, Political Economy, History, History and Statistics of the United States, Principles of Teaching, Hebrew, German, French and Spanish, Drawing, Painting, Vocal and Instrumental Music, Algebra, Geometry, Plane and Spherical Trigonometry, Mensuration, Navigation, Surveying and Engineering, Conic Sections, Differential and Integral Calculus; Chemistry and Natural Philosophy, illustrated by apparatus and experiments; Astronomy, Mechanics, Hydrostatics, Technology, Vegetable Physiology, Topography, and Architecture.

Meteorological returns, more or less complete, embracing observations upon the thermometer, the wind and weather, were made by forty-three academies, which are scattered over an extent of six degrees of longitude, and about four degrees of latitude. We give some of the most interesting summaries.

The annual mean temperature, as deduced from the average of the complete returns of thirty-four academies, is 47·47°; the highest degree during the year, (99°) was observed at Dutchess County and Montgomery Academies; and the lowest, (−30°,) at Gouverneur and Oxford; greatest annual range (128°,) at Gouverneur; greatest monthly range (84°,) at Oxford; a remarkable uniformity appears in the climate during the winter, from the fact that the coldest day at thirty-five places, occurred, with three exceptions, upon the 26th or 27th of January; at eighteen places, the 26th was coldest.

The prevailing winds for the year were, south at sixteen places, south-west at ten, and north-west at six. Average of rain and snow at thirty-three places, 37·21 inches; greatest quantity, 53·46 inches, at Kinderhook. August was the wettest month at seventeen places.

The miscellaneous observations, collected from the "Reports," and from periodicals, upon the progress of vegetation, &c., aurora borealis, haloes, meteors, earthquake, and weather, are very numerous and interesting.

Mineralogy has its observer, as appears from one of the Reports; botany holds a prominent place, as indicated by two catalogues; one of the indigenous, *Flowering* and *Filicoid* "plants growing within twenty miles of Bridgewater, Oneida County, N. Y." by A. Gray, M. D., embracing 777 species ; and another, of the plants growing in the vicinity of Cortland Academy, by George W. Bradford, M. D., containing 563 species, exclusive of the class Cryptogamia and the Grasses. There is a table of the latitude and longitude, and elevation of the places where the academies are situated.

Very complete records, kept by T. Romeyn Beck, M. D., at Albany, for the last thirteen years, together with tables of several previous years by other gentlemen, enabled him to make the following abstract.

He verified the observation of Humboldt, that the "mean temperatures of the year, obtained by *two* or *three* observations, do not differ sensibly, if the intermediate observation be sufficiently distant (four or five hours) from the observation of maximum and minimum." In taking the annual averages of the mean temperatures of the observations, thus made during eleven years, he found them to differ by only 0·45.

He ascertained the mean temp. of Albany, from the observations of seventeen years,	to be 49·04°	
Highest point of the thermometer,	100°	in 1820.
Lowest do. do.	—20°	in 1796.
Greatest range,	120°	

The weather for 15 years gives an annual average of nearly 200 fair days.

Rain, annual average, 79 days.

Snow, do. 22 "

Rain gage for 7 years, annual average, 40·64 inches.

Winds 15 years—south 1509½ days, or an annual average of 100½ days.

Humboldt states that the isothermal line of 50° passes near Boston ; and on comparing the results obtained at Albany, with those upon which he founded his conclusions, we discover a very close approximation.

Humboldt, in opposition to Kirwan, asserts, that the mean temperature of October approaches nearer to that of the whole year, than the mean temperature of April. Dr. Beck finds from the observations of seventeen years, (which include the results of several very intensely cold winters,) the average mean temperature of the year, to be 49·04° ; of October, 50·63° ; of April, 48·38°.

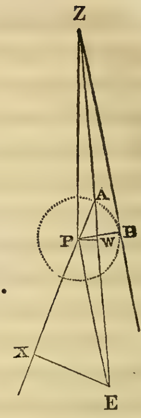
According to Dr. Brewster's formula for finding the mean temperature of a place, that of Albany is 50·3191°.

The Regents, sensible of the value to science and to the whole landed interest of the State, of a record of the variations of the needle from year to year, have addressed a circular to the Colleges and Academies, requesting them to make observations upon this point, and to attain accuracy and uniformity in the results, the Chancellor has furnished a formula for establishing a true meridian, and the most important particulars to be regarded in observing, between it and the magnetic meridian.

This circular being drawn up with great judgment and ability, and being of general as well as local interest, we now republish, as being the most effectual mode of expressing, at once, our good will to the very important object in view, and of giving the circular the range of this Journal.

An indispensable prerequisite is to have a true meridian established, indicated by fixed and permanent monuments. The manner in which this is to be done, in order that it may be accurately established, requires special directions.

In years past, a rule has been prescribed for obtaining an approximate meridian, supposed sufficient for common purposes; that is, to take the direction of the pole star when it is in the same vertical or perpendicular line with *epsilon ursæ majoris*, called *Alioth*, that is, the first star in the tail of the Great Bear, or the one next to the four most conspicuous in that constellation. This rule was once correct, but it is more than a century past: since that, the interval between the time when these two stars are in the same vertical, and the time when the pole star is in the meridian, has been gradually increasing, on account of the greater annual increase of the right ascension of the *pole star* than that of *Alioth*. Still some, not aware of this fact, have continued to prescribe the ancient rule. Others have calculated the interval for a certain period of time, without adverting to the changes which would occur in succeeding periods. In order to practice on this rule with accuracy, calculations must be made for the time when it is adopted, and for this purpose the following formula is given as an example, adapted to the beginning of this year and a medium latitude, which will give a result sufficiently accurate for every part of our state, and which may be adopted in practice without producing a sensible error for several years, for the purpose now contemplated.



A. Ursæ minoris or pole star.
Z. Zenith.
P. Pole.
E. Epsilon Ursæ majoris, or Alioth.
PZ. Co-latitude.
B. The place of the pole star at its greatest azimuth.

The time required for the pole star to arrive at the meridian, after it is in the same vertical with Alioth, is thus calculated for the latitude of 43° north, on the 1st January, 1833.

	Right Ascensions. H.	M.	S.	*N. polar distances.*		
E Ursæ majoris or Alioth,	12	46	42	33°	08′	00″
A Ursæ minoris or pole star,	1	0	19	1	34	53
Diff. of R. A. 176° 35′ 45″=11		46	23			

In the annexed figure of the spherical triangles, *aPe* and *aPz.*

Given the Co-latitude, *ZP*, - - - -	47	00	00
The N. P. distance of the pole star, *Pa*, - -	1	34	53
The N. P. distance of Alioth, *Pe*, - - -	33	08	00
Diff. of right ascensions, *aPe*, - - -	176	35	45
The supplement of *aPe*, *ePx*, - - - -	3	24	15

Required the angle aPz = the distance of the pole star from the meridian at the time of observation.

Produce *aP*, and from *P* and *e* let fall the perpendiculars *Pw* and *ex*. Then,

1. Cot. Pe : R : : Cos. ePx : Tang. Px, and $Px+Pa=ax$.
2. Sine ax : Sine Px : : Tang. aPe : Tang. $Pae=Paw$.
3. Cot. Pa : R : : Cos. Paw : Tang. aw.
4. Cos. Pa : Cos. Pz : : Cos. aw : Cos. zw, and $zw-aw=az$.
5. Sine Pz : Sine az : : Sine Paz : Sine aPz; the angle required.*

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* The calculation may also be made as directed by the sixth and seventh cases of Oblique Spherical Trigonometry, given in Simson's Euclid.

By this process it is found that the angle *aPz* is 3 degrees and 11 minutes, which is equal to 12 minutes and 44 seconds of time; showing that in latitude 43° N. on the 1st of January, 1833, the pole star came to the meridian 12 minutes and 44 seconds after it was in the same vertical, or cut the same plumb line with epsilon ursæ majoris or Alioth. The lower the latitude of the place, or the greater the distance between the zenith and the pole, the greater will this interval be. This fact alone shows how vague the rule is which has been recommended without due qualifications.

The place of Alioth is taken from the *Connaissance de Tems* of 1830, and corrected for January, 1833; and the place of the pole star is taken from the Nautical Almanac of this year.

In preference to this method, the following is recommended as that most commonly used by astronomers, and requiring less calculation, in order to establish a true meridian line.

Given, the latitude of the place and the north polar distance of the north star. Required, the angle *Pzb*, its greatest azimuth.

The latitude of the place may be taken from the map of the State with sufficient accuracy for the purpose, for a small variation in this will not sensibly affect the result.

The north polar distance is given in the annual Nautical Almanac.

From these data, find the pole star's greatest azimuth thus:

As the cosine of the latitude of the place is to radius, so is the sine of the north polar distance of the pole star to the sine of its greatest azimuth, the angle *Pzb*.

The latter part of September, or the beginning of October, is the most convenient time for making the observation, for then the pole star will reach the place required soon after it becomes visible in the evening; and, as a direction about the time, it may be observed that on the 1st of October next it will be in that position about 50 minutes after sun-set, to which may be added about two and a half minutes for every day back, and about as much deducted for every day forward. On the 1st of October, the pole star will be at its greatest azimuth at about 38 minutes after 6 o'clock in the evening, apparent time, or 28 minutes after 6 o'clock, mean time; that is, the time shown by a well regulated clock, and four minutes earlier on each succeeding day.

The time when the polar star will be at its greatest azimuth, on any given day, is found thus. Subtract the right ascension of the sun from the right ascension of the star. This will give the time when it passes the meridian: from this deduct 5 hours and 54 minutes, which will give the time required, when the azimuth is east; but when it is west, the 5 hours and 54 minutes must be added to the time of the transit. This is a medium for our State, and although it will vary with the latitude, it will not differ one minute from the truth, between the extremes of our northern and southern bounds.

It is recommended to every college and academy to provide itself annually with a Nautical Almanac, in order to enable its students to exercise themselves in lessons of practical astronomy, and, among others, such as those of which this circular gives specimens.

In order to make the observations as correct as possible, a good transit instrument is required, and the observations should be several times repeated. Astronomers never trust to a single observation, for it may be, and often is affected by the peculiar state of the atmosphere, but they make a number in succession, and take the mean of them, rejecting those which differ much from the others.

The instrument should be directed to the star some time before it has made its greatest apparent departure to the east or west, and follow it until it becomes stationary; then bring the telescope of the instrument to a horizontal position and mark the place to which it points, at a considerable distance from it. Let this be as far as the evenness of the ground will admit; then measure the distance between the instrument and the mark so made: the offset from which to the meridian is thus found, by plane trigonometry:

As radius is to the distance between the instrument and the mark, so is the tangent of the azimuth, as before calculated, to the offset to be made west, when the azimuth is east, at right angles from the line of observation; then a line drawn from the place of the instrument, through the termination of the offset, will be the true meridian, on which, at a convenient distance from each other, stable and permanent monuments ought to be placed; such as stones sunk deep into the ground, and having on their faces lines drawn to show with precision the course of the meridian.

Where no transit instrument is possessed or can be procured; as the means of an approximation to a true result, a plumb line may be used, and by it the observations conducted in the manner now prescribed. In such case the upper end of the line should have as high a fixture as can be conveniently obtained, and to its lower end should be fastened a heavy weight, immersed in a vessel of water to steady it. A light will be required to illuminate the plumb line to render it visible, and another to keep in the line of observation and to mark the point where it terminates.

The usual means should be employed to ascertain the fact that there is nothing about the place by which the needle may be attracted.

Within the limits of the State of New York, the following method is practicable, and, if carefully conducted, will give a meridian as true, for the present purpose, as can be expected from the other prescribed methods.

Alioth and *Gamma Cassiopeiæ* pass the meridian at the same moment, within two seconds of time, the one below and the other above the pole. If then the line be accurately observed in which they appear when in the same vertical, that line will be the true meridian, without an appreciable error; and as the difference between the changes in right ascension of these two stars is only 13 hundredths of a second annually, it will not sensibly affect the accuracy of the rule and its practical results for many years.

At some distance beyond our north bounds these stars will so nearly approach the zenith as to render the observation inconvenient, with a plumb line, but not with a transit instrument at any place farther to the north. The observation will be practicable either way, as far south as the 35th degree of north latitude, whence *Gamma Cass.* will be seen at its lowest depression, somewhat less than five degrees above the horizon. In latitude 43°, *Alioth* will come within 14 degrees of the zenith, and *Gamma Cass.* within 13 degrees of the horizon, at the time when the observation is recommended to be made, which is from the middle of May to the 1st of June. On the 15th of May, the stars will be on the meridian at about 19 minutes after 9 o'clock in the evening, apparent time, and about four minutes earlier on every succeeding day.

Gamma is the middlemost of the bright stars that compose Cassiopeia's chair.

The meridian line being thus accurately and permanently fixed, (and this ought to be considered as an indispensable appendage to every college and academy,) observations should be made on it at least once in every year, in order to ascertain the difference between it and the magnetic meridian. For the sake of uniformity, let this be done in October.

These observations should be made early in the morning, for it is well known that the variation of the needle will be increased, sometimes to the amount of 15 minutes, between sun-rise and the middle of the afternoon, and that it will, before the next morning, return to its mean direction.

Much useful information may be obtained by examining well marked lines of various ages, and comparing their present with their original magnetic bearings.

In regard to the subject now presented to your notice, the Regents claim no mandatory authority, especially over colleges; it therefore comes to you as a recommendation, that you will co-operate with those who preside over other institutions, for carrying into effect a measure deemed important for the promotion of science, and which may be considered of still greater importance in matters touching conflicting claims between individuals of our State. It is therefore hoped that, impressed with a due sense of the general purposes for which the institution over which you preside has been created, this representation, made on behalf of the Regents, may not be disregarded, and that hereafter they may be furnished by the colleges and academies, in their annual reports, with observations made by them on the direction of the magnetic needle compared with that of the true meridian, and that a detailed account be given by each, of the manner in which its meridian line has been established.

To such institutions as are not provided with good compasses, those made by Mr. Hanks, of Troy, having a vernier appended to one end of the needle, are recommended as the best that can now be procured. S. De Witt, *Chancellor.*

We learn from Mr. De Witt, that should the regents be favored with the results of observations made in colleges and academies, and doubtless by duly qualified individuals in other states, they will be noticed in the annual reports and published in the legislative documents.

We beg leave earnestly to recommend this subject to the attention which it so well deserves. It is an object of great national importance, and the effort could not originate from a more respectable source.

We understand that to enforce the importance of making observations and of preserving records of the variations of the magnetic needle, while surveys of the public lands are made, the following interesting facts have been mentioned to the Secretary of State, and as the importance of the recommendation is not diminished but rather enhanced by time, we republish the statement.

After the passage of the act of Congress of 1796, organizing the United States Land Office, the very responsible appointment of Surveyor General was tendered by General Washington to the Hon. S. De Witt, the present Chancellor of the Regents of the University of New York. Had he accepted the office, he would have recommended to the government to obtain a number of cheap portable transit instruments, like one which he has since had made for his private use and employed in astronomical observations. He would then have directed *standard lines* to be run on the true meridian, through the public lands; and that all the lines for townships, sections and subdivisions, should, after comparing compasses with those standard lines, be run at right angles and parallel to them. For the want of such precautionary measures, serious evils, it is apprehended, will be experienced.

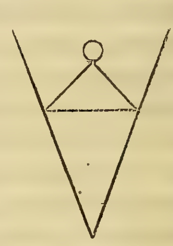
If we suffer evils from the negligence or inattention of those who have preceded us, it is our duty to provide that those who shall succeed us do not suffer similar evils through our negligence or inattention. The measures adopted by the University of the State of New York are dictated by such principles, and are intended to remedy or prevent such evils.

It has also been suggested to the Secretary of War, to give instructions to the officers of the different military posts, to add to the meteorological observations which they are enjoined to make, observations also by the rain gage; it has been recommended to use the simple one of which a description was published in this Journal for July, 1832, (Vol. XXII, p. 321,) as preferable to those before employed. Of this fact, Mr. De Witt has become more thoroughly convinced by examinations, lately made, of the manner in which observations have been conducted by the gages first furnished to the New York state academies; and they are about substituting the nine inch rain-gages, as more to be relied on.

With this view, a scale for the nine inch rain-gage has been engraved, to enable any one to make a trial of it. In order to fix the scale for use, have a board prepared, of thoroughly dried wood, twelve inches long, one inch and a half wide, and one eighth or one third of an inch thick. Trim the print by the lateral lines. Spread thin paste on the back of it, and leave it wet until it has expanded to the measure between the extremes of the graduation; then press it to the board, so that there shall be exactly nine inches between the zero of the scale and its highest degree—the lowest edge of the paper to coincide with the lowest edge of the board.

The measuring stick should be a very thin flat piece of wood, about half an inch wide, sloped at its lower end to a point. As a substitute for varnish, some coats of thin flour paste may be put on the face of the scale, having one well dried before another is put on.*

Although the direction for the management of this gage is that the water in it shall be measured immediately after every fall of rain, in order to have the advantage of the large degrees at the lower end of the scale, still, in order to guard against any evaporation, in consequence of an occasional delay in measuring the water, a small addition has been made to the gage, of which a description has already been given in this Journal. It is a hollow cone of tin, having (if the base of the gage be six inches) a base of four inches, and being two and a half inches high, with an appendage at the apex for a handle. This is put down into the gage, with its base downwards, and however closely pressed into it, a sufficient crevice will be left for the water to pass through it to the lower part of the gage.



In a letter from Mr. De Witt to the Editor, dated August, 1833, are the following very just remarks.

"If it is not now clearly discernible what practical use can be derived from observations by the rain-gage, yet, considering the little trouble attending them, and the possible deductions of utility to which they may ultimately lead, the keeping of a record of this branch of meteorology is entitled to a systematic provision.

"When it was first observed that sealing wax, amber or glass, on being rubbed, would attract light bodies, who could have thought that this would lead to the wonderful discoveries since made in electricity, to our acquaintance with the nature of lightning, and the means of paralyzing its tremendous power? Facts like these should teach us that observations on the phenomena of nature, however trifling they may at present appear, may, if records of them be kept, at some future time contribute to improvements in abstract science or practical knowledge, such as, if now predicted, would appear incredible, if not impossible."

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* This has been found not to answer as well as map varnish which has been used for the scales. From fifty to sixty have been neatly made of copper at one dollar, for the academies; they are furnished with a scale and measuring stick.

Art. III.—*Upon Caloric, as a Cause of Galvanic Currents;* by Prof. John P. Emmet.

The subject, for the illustration of which the following inquiry was instituted, is one of undiminished interest to the philosopher, who, notwithstanding the able controversies hitherto maintained between the champions of simple contact on the one hand, and those of chemical action, upon the other, must still feel abundantly convinced that the theory of galvanic action is yet but imperfectly understood. Scarcely has opinion settled down, ere a new view of the question, brought to light by Faraday, and matured by Nobili, Antinori and others, rises up to convince us that this same galvanism *can* exist independently of either caloric or chemical action; and we are compelled to admit, that, however important these causes may be, *magnetism* is fully as much so.

Indeed, if we look to the matter closely, there is reason for believing that magnetism is the most elementary agent, since *it is always present*, whereas the others are not. Thus, when galvanism is produced by the contact of acid and dissimilar metals, or by that of the latter alone, under the influence of heat, magnetism appears in every portion of the apparatus, and no method has hitherto been devised for determining which precedes the other. Magnetism, in these cases, may, therefore, be the cause of the galvanic currents, instead of the effect; whereas, in the experiments with the horse-shoe magnet, there is no reason for believing that either caloric or chemical action is, even in the most indirect manner, connected with the results, but on the contrary, that the only cause is magnetism.

Applying the same reasoning, we are led to conclude that caloric is a more general agent than chemical action; since the former is set free in every case of galvanic excitation, depending either upon salts, acids, or inequality of temperature; whereas there is no influence from chemical action, as Becquerel has proved, when two metals are brought into contact and heated. Under such circumstances, we might almost feel justified in concluding, that whenever chemical action seems to be necessary for the effect, its true agency consists in putting caloric or magnetism into motion. The great energy of the common galvanic battery may be urged as an objection to this opinion, that caloric is the general cause of galvanic currents; since we find that a very high temperature is necessary before we can produce similar currents by the contact of metals, unequally heated. But we must not overlook the marked peculiarities of each mode. Chemistry would be a science of combustion, but for the *fluids* that are employed in our experiments; acids would ignite the metals when they oxidate them, just as chlorine is now known to do, could we furnish *condensed oxygen*, and dispense with water. By the peculiar construction of the galvanic battery, the oxygen is presented in this state, and the oxydizable metal always acquires an elevation of temperature so considerable, that, according to M. Parrot, the crust of oxide formed upon its surface, at each instant, is red hot. (Ann. de Chimie, 1829.)—But a far more important difference may be pointed out. In the *thermo-electric* combination, the metals are in actual contact at the very point where the galvanic currents originate, by the application of heat, and this must undoubtedly prove a point of annihilation for much of the electricity, generated. In the galvanic battery, on the contrary, an imperfect conductor is interposed between the metals which generate the currents, so that the latter are compelled to seek an union through the conducting wires. If, however, we make the metals touch, *under* the acid or saline bath, the result is more like that of the close thermo-electric combination, for the galvanic currents, instead of coursing through the circuit wires, as usual, actually exhaust each other by combination at the point of contact, so as to exhibit little or no signs of existence outside of the solution.

It is not, however, my object to discuss the merits of this question, nor do I desire to be considered as having very settled opinions upon a subject still so very conjectural. The enquiry, of which I shall proceed now, to furnish details, originated from an impression that caloric was a very general agent of galvanism, and it was conducted to the termination at a period, when, from the effects of a most serious accident, I was compelled to confine myself to my bed. The leisure which thus presented itself for several weeks, though not unaccompanied by pain, enabled me to arrive at some results which are here offered, solely because they appear to have escaped the notice of other chemists, and not with any confident expectation that they can fill up the hiatus which now exists, or lay the foundation for any new theory.

Notwithstanding the very obvious relations between common and voltaic electricity, it appears highly probable that the practice, which has hitherto prevailed, of employing a common language and similar modes of investigation for both, has not only been productive of false general views, but has seriously retarded the developement of the laws which characterise galvanism. Volta's very ingenious attempts to show that metals give rise to electricity by contact, are of this character, inasmuch as they lead to the conclusion that the activity of the pile is dependant upon ordinary electricity; whereas no such result will be obtained, if we view these electricities in other respects. It seems to be no small perversion, to use the gold leaf electrometer for the analysis of a battery, composed of two metallic plates, when it is well known that this instrument, even with the assistance of doublers, is incapable of indicating the *galvanic* currents of a battery composed of several hundred plates. Yet such was the instrument in common use, until Oersted pointed out the value of the magnetic needle. Even now, that we possess this highly appropriate and delicate indicator, we incline strongly to confound ordinary electricity with galvanism, notwithstanding that the former, in its most concentrated condition, has no marked influence upon the galvanometer. Whatever may be our inclination to generalize, these simple instruments can alone sustain the opposition, since each one is excessively delicate towards its appropriate fluid, and absolutely good for nothing, for the other. Very many circumstances might be mentioned, in order to prove that common and voltaic electricities should be considered, in our investigations, as essentially different; and the late discoveries with the magnet seem to point strongly to some ulterior and elementary condition, which must certainly, ere long, give us more correct views, and, most probably, mark the distinction, here noticed, more closely.

To this limitation I shall confine myself, at all events, and wherever the term electricity may appear in my remarks, it must be understood to refer to galvanism, unless the contrary be stated. The experiments were made with a galvanometer consisting of about one hundred coils, and constructed like the multiplier.

The simplest view of the relation, existing between caloric and galvanism, is presented by thermo-electric combinations: I shall, therefore, proceed first, to this portion of the subject and reserve my remarks upon hydro-electricity, or that produced by metals and chemical solutions for a subsequent communication.

Thermo-electricity.—We are indebted chiefly, to the investigations of Cumming, Becquerel and Nobili, for most of the particulars which relate to the electric powers of *combined* metals, when exposed to heat, and it appears clear from their results, that the currents originate at the very point of contact. This fact, taken in connection with the views advanced by Volta, in order to explain the action of his pile, seems to have led persons to suppose that the contact of *dissimilar* metals was necessary, and accordingly, almost all the results obtained, upon the subject of thermo-electricity, relate to the combination of different metals. Yet it is easy to show, by the galvanometer, that two portions of the same metal, are capable of acting upon each other, and that the currents, thus generated, depend solely upon the direction which the caloric is made to take. Thus, I found, that, when a hot fragment of *bismuth*, was made to touch a *cold* one, the former constantly transmitted a positive current to the galvanometer; whereas, when fragments of *antimony*, unequally heated, were brought into contact, the hot portion, invariably, conducted the negative current. These two metals are, therefore opposite to each other, in this respect, and when combined, must from the point of contact, send forth the two fluids in opposite directions. All the other metals, tried, were capable of producing currents by the simple contact of their own particles, unequally heated, but bismuth and antimony possess the greatest power. The currents cease almost immediately, upon the contact of particles, obviously, because the inequality of temperature, is thus at once destroyed; whereas, when dissimilar metals, are heated in contact with each other, the difference of temperature, must still subsist owing to the greater capacity for caloric and conducting power of one of the metals. In such cases, the direction of the galvanic current, is determined by the direction which the excess of caloric takes through the metallic medium. Heating one fragment *before its contact* with the other, enabled me, in most cases, to determine the directions which the caloric and galvanic currents take, and the results, I think, will show that this mode of investigation is of the utmost importance. The following tabular view represents, nearly, the order in which the metals stand in relation to their elementary galvanic powers. The caloric, it is obvious, must be considered as proceeding from the hot fragments to the cold as long as there is any difference of temperature.

Contact between portions of the same metal unequally heated.

Increase of heat devel-opes a {

pos. current in—antimony, arsenic, platinum, copper and silver. (*Law—caloric and pos. current move together*)

neg. current, in lead, tin zinc, gold, iron, mercury? nickel and bismuth. *Law—opposition*)

These results, satisfactorily prove, that the metals are capable of assuming either state of electricity, according to the direction which the caloric takes, and it will be seen that the effect of association between dissimilar metals, is dependent upon these elementary forces. The order, above given, can be accurately represented only by a measurement of the deviations from the magnetic meridian, as indicated by the galvanometer needle; this, however, I have not been able, hitherto, to execute with the requisite degree of precision, and all, therefore, that is here aimed at, is the representation of the general electrical states of the different metals, under the same conditions of heat.

It is obvious, although there are exceptions which will be noticed presently, that the electricity, thus generated by caloric, corresponds with the chemical habitudes of some of the metals. Thus an increase of heat makes lead, zinc, iron, &c. transmit a *negative* current, and these metals may, therefore be regarded as becoming more *positive* by the operation, the result of which is an increased affinity for electro-negative elements, such as oxygen, so as to render them not only easy of oxidation, but difficult of reduction, when exposed to mere heat: whereas platinum and silver by becoming more negative, at high temperatures, must exhibit a facility of reduction, and other properties the opposite of the former metals. Modifications of this law, arising from volatility, fusibility, &c. must always occur, but still the conclusion will be an important one, if it can be shown, by any experimental process, that bodies possess a susceptibility for both electrical states, depending upon the amount of free caloric within them, and not wholly upon the contact of dissimilar matter.

The galvanometer, however, indicates formidable exceptions to this rule, which must not be passed over. Antimony, for instance, stands first among those metals whose particles, by an increase of heat, transmit a positive current, and it may, therefore, be regarded as becoming more negative by the process.—Yet antimony is easily oxidated when heated. The volatility of this metal will, in a great degree account for this result, since it becomes covered with crystals of the oxide at a temperature much below that necessary to make it obscurely red hot; but the well known attraction which cold antimony, in powder, has for chlorine, another electro-negative element, does not admit of so favorable an adjustment.

The position of gold, moreover, does not indicate its chemical habitude, since it occurs among the metals which are made *positive* by heat. The currents produced by fragments of gold, are always feeble, and when copper is also present, the oxidation at the surface makes it almost impossible to distinguish any effect.

Tin and lead furnish very equivocal results, even when one portion of the metal is as cold as ice, and the other heated, nearly to fusion. This is perhaps owing, in a great degree, to oxidation. Zinc and silver must be heated in a coal fire and large bars used in order to obtain currents of sufficient force. The arsenic, employed, was the crude article of the shops; but its indications were sufficiently conspicuous when one of the fragments was heated until the white vapor of arsenious acid appeared.

When *dissimilar* metals form the thermo-electric circuit, we do not perceive the relation which the elements have towards caloric. Becquerel is of opinion that the forces, as observed by him, bear a direct relation to the radiating power of the combined metals, (Ann. de Chimie &c. 1829,) but, most assuredly, this explanation is not applicable to the combination of portions of the *same metal*, and it appears obvious, that in such cases, the direction and intensity of the current result from the course which the caloric takes, during its transmission from the hot portion to the cold.

It appears evident from the results furnished in the foregoing table, that the metals naturally divide themselves into two classes; in the one (including bismuth, nickel, mercury, iron, gold, zinc, tin and lead) *the positive galvanic current moves in opposition to the caloric;* in the other, (consisting of silver, copper, platinum, arsenic and antimony,) *these currents coincide.* The cause of this difference is by no means apparent, but it is obvious that it must operate with equal force in modifying the currents produced by the contacts of different metals. Pursuing the principles of investigation already described, for elementary combinations, it is easy to determine the influence which caloric exerts upon compound thermo-electric circuits, or those consisting of dissimilar substances. The process consists in connecting each metal with the galvanic multiplier; one of them is then to be heated, in order to ensure the direction of the caloric, and in this state, made to touch the other metal which preserves its natural temperature.

The result invariably proved to be that the caloric, proceeding in one direction, which varies, however, for each combination, either diminishes, destroys or inverts the currents which the same metals are capable of generating, when placed in contact *previous to the application of heat.* In general, very small fragments or wires, and the flame of a spirit lamp, will furnish satisfactory results; but, in some instances, one of the metals must be employed in large masses and the requisite temperature obtained by a charcoal fire.

The disturbance of the ordinary currents, is momentary, or at least, lasts only while the difference of temperature continues so great as to give the caloric a direction *contrary* to that which it would take when the metals are heated in contact with each other.

A few examples will render the nature of these modifications more apparent.

Antimony, when heated *in contact* with the following metals, bismuth, nickel, copper, platinum, &c. invariably conveys a positive current to the galvanometer; but when made obscurely red-hot, *previous* to the contact, its polarity becomes reversed with every metal tried, except bismuth, nickel and mercury, which, being at the remote end of the thermo-electric scale, in relation to antimony, exhibit only a feeble diminution of force. The conclusion obviously to be drawn from this example, is, that antimony, while in contact with copper, platinum and most other metals, *receives* caloric from them; because, when, by excess of heat, it is compelled to give it out, the ordinary galvanic currents become reversed. Another result is, that in such cases *the caloric and positive current move in the same direction.* Upon referring to the electrical condition of its particles, when unequally heated, as before stated, it will be seen that an increase of heat makes antimony transmit a positive current, so that it is obvious, this metal governs the currents proceeding from the combinations just noticed, according to its own *elementary condition* in relation to caloric.

Bismuth furnishes examples of the opposite character. Its polarity continues uniform, whether it is heated in contact with the metals, or whether the latter are made hotter or colder, previous to the contact. But, in most cases, its power of transmitting a *negative* current is diminished when the caloric is made to proceed from it, and, as this diminution is undoubtedly indicative of a tendency towards *inverted* polarity, we may infer that in all its thermo-electric combinations, it acts by receiving caloric, like antimony—such a conclusion is strengthened by the elementary condition of its own particles, which, it has been shown, become capable of transmitting a *negative* current by an accumulation of caloric. This metal, therefore, like antimony, governs its combinations according to the elementary electricity peculiar to itself, and which always exhibits *the positive current moving in opposition to the caloric.*

The other metals are intermediate, in their power, between these two; and, we find one or other of the foregoing laws prevailing according to the nature of the combinations.

Arsenic is, most decidedly, a regulating metal, and its influence is in accordance with the elementary condition, as laid down in the table. There it is stated that an increase of heat enables this metal to transmit to the galvanometer a positive current, and when associated, it is found to act most powerfully whenever it is colder than the other metals, previous to contact. Indeed there is little or no effect if the caloric is made to proceed from the arsenic, except in the cases of bismuth, nickel and mercury. In every instance the positive current passes through the arsenic, when the caloric does so, but the polarity is inverted when the hot metal is made to touch cold antimony. There is abundant evidence of a tendency towards the same inversion, when cold platinum, copper, silver, lead, tin, iron or zinc is employed, because, under these circumstances, there is no current rendered manifest, and, accordingly, we may conclude that arsenic, like antimony, governs its combinations, excepting where bismuth, nickel or mercury enters as an element, by the law *that caloric and the positive current move together.*

Mercury. The exact relation between unequally heated portions of this metal was not determined, owing to its fluidity, but a sufficiently close approximation may be obtained by amalgamating a piece of lead until it becomes able to sustain a drop of mercury—another portion of the fluid metal is then to be heated in a vessel, over a spirit lamp, and after having connected both portions of the mercury with the galvanometer, the suspended drop is to be brought into contact with that which is heated. It will thus be perceived that the portion which *receives* the caloric, transmits the negative current. In its combinations with other metals, the mercury usually receives caloric, and when by previous heating, it is made to give it out, upon contact, its power is obviously diminished. In two or three cases the polarity even becomes inverted. Thus, cold mercury is *negative*, as to the current, with hot zinc, but *positive* when the zinc receives the caloric. Tin and silver seem to furnish similar results, but, the combinations being extremely weak, the effects are difficult of observation.

The combination between zinc and mercury will enable us to trace the relation which the direction of the caloric bears to that of the positive current, for if these metals are heated together, the mercury transmits a *negative* current. The contrary is shown to be the case when this metal *gives out* caloric to the zinc, and the inference, therefore is, that in the usual combination, where contact is first established, the mercury receives caloric from the zinc, and, accordingly, *the caloric and positive current must move in opposition to each other.* This result corresponds with the law of its own particles, as given in the table, and is moreover exemplified by the combinations between mercury and the metals, iron, silver, antimony, tin and arsenic, provided these metals are made hotter than the mercury. The caloric and positive current move together, however, in the combinations of hot mercury and cold iron, cold antimony and cold arsenic.

The other thermo-electric combinations furnish results which vary for each case; it will not, therefore, be necessary to explain their peculiarities farther than by the tabular view which follows, and with which I shall close this communication. The relative direction of the caloric and galvanic currents may thus easily be perceived, and by consulting the table already given for the elementary condition of each metal, under the influence of temperature, we may generally arrive at a knowledge of that one which governs the currents. To facilitate the application of the principles indicated in the preceding remarks, I have represented the direction of the caloric by an arrow with a head composed of dots, and feathered at right angles to the shaft. The course of the *positive* galvanic current is indicated, on the other hand, by an arrow of the usual form.

	Positive current and caloric moving together cold. + hot. −	Positive current and caloric moving in opposition hot. − cold. +	Remarks.
Bismuth . .	. . . . . .	B. & B.	The combination of 2nd column most usual: but it appears manifest that as soon as the Bismuth is heated sufficiently to give off a current of caloric to the other metals, it loses its regulating power.
and			
Antimony. .	A. & B.	A. & B.	
Arsenic. . .	A. & B.	A. & B.	
Platinum. .	P. & B.	P. & B.	
Copper. . . .	C. & B.	C. & B.	
Silver. . . .	S. & B.	S. & B.	
Lead.	L. & B.	L. & B.	
Tin.	T. & B.	T. & B.	
Zinc.	Z. & B.	Z. & B.	
Gold.			
Iron.	I. & B.	I. & B.	
Mercury. . .	M. & B.	M. & B.	
Nickel. . . .	N. & B.	N. & B.	
Antimony	A. & A.		No. 2. first column, most usual and powerful; hence it is obvious that the elementary state of the antimony regulates the currents.
and			
Arsenic. . .	1. A. & A. 2. A. & A.		
Platinum. . .	1. P. & A. 2. A. & P.		
Copper. . . .	1. A. & C. 2. C. & A.		
Silver. . . .	1. A. & S. 2. S. & A.		
Lead.	1. A. & L. 2. L. & A.		
Tin.	1. A. & T. 2. T. & A.		
Zinc.	1. A. & Z. 2. Z. & A.		
Gold.	1. 2.		
Iron.	1. A. & I. 2. I. & A.		
Mercury. . .	A. & M.	A. & M.	Combination in 2nd column most usual and powerful; in the 1st combination, the antimony governs, in the 2nd the mercury.
Nickel. . . .	A. & N.	A. & N.	In the combination of 2nd column, the nickel governs the current of
Arsenic . .	A. & A.		In all these cases the elementary condition of the arsenic regulates the galvanic currents. The galvanometer does not indicate any result for the combinations of the 2nd column.
and			
Platinum. . .	A. & P.		
Copper. . . .	A. & C.		
Silver. . . .	A. & S.		
Lead.	A. & L.		
Tin.	A. & T.		
Zinc.	A. & Z.		
Gold.			
Iron.	A. & I.		
Mercury. . .	A. & M.	A. & M.	In the combination of the 2nd column, the *mercury* regulates the galvanic currents.
Nickel. . . .	A. & N.	A. & N.	In the combination of the 2nd column, the *nickel* regulates the galvanic currents.

	Positive current and caloric moving together (*cold.* + , *hot.* −)	Positive current and caloric moving in opposition. (*hot.* + , *cold.* −)	Remarks.
PLATINUM and	P. & P.		
Copper. . . .	C. & P.	C. & P.	The combination in 1st column most usual. The 2nd combination difficult of exhibition.
Silver. . . .	S. & P.	S. & P.	The currents not apparent unless at a red heat. They are not inverted even when the silver is fused.
Lead.	L. & P.		No current for 2nd column, even when the lead is heated to fusion.
Tin.	T. & P.		The same as for lead.
Zinc.	Z. & P.	Z. & P.	The combination of 1st column most powerful.
Gold.	G. & P.	G. & P.	
Iron.	1. I. & P. 2. P. & I.		No. 1. first column most usual. The other only apparent when the iron acquires a full red heat; oxidation must be avoided.
Mercury. . .	M. & P.	M. & P.	Combination in 1st column, most usual.
Nickel. . . .	1. N. & P. 2. P. & N.		
COPPER . . and	C. & C.		
Silver. . . .	S. & C.	S. & C.	The 1st combination most powerful. The 2nd often imperceptible.
Lead.	. . . .	C. & L.	With *cold* copper, no perceptible currents.
Tin.	T. & C.		The same as for lead.
Zinc.	Z. & C.		A red heat necessary for the copper.
Gold.			
Iron.	. . . .	1. I. & C. 2. C. & I.	No. 1. of these combinations, the most powerful. No. 2. only perceptible when a fine copper wire is kept red hot in the flame and touched, without removal.
Mercury. . .	M. & C.	M. & C.	
Nickel. . . .	. . . .	1. N. & C. 2. C. & N.	
SILVER . . and	S. & S.		
Lead.	. . . .	S. & L.	No current perceptible when the silver is cold.
Tin.	. . . .	S. & T.	Very feeble at all times.
Zinc.	1. S. & Z. 2. Z. & S.		No. 2, feeble.
Gold.	S. & G.	S. & G.	
Iron.	. . . .	1. I. & S. 2. S. & I.	No. 1. most powerful.
Mercury. . .	. . . .	1. S. & M. 2. M. & S.	
Nickel. . . .	S. & N.	S. & N.	
LEAD. . . . and	. . . .	L. & L.	
Tin.	. . . .	T. & L.	Hot lead no effect; even the tin requires a heat near the point of fusion.
Zinc.	Z. & L.	Z. & L.	Hot lead little or no effect.
Gold.	. . . .	G. & L.	Hot lead no effect.
Iron.	I. & L.	I. & L.	
Mercury. . .	. . . .	M. & L.	Hot lead little or no effect.
Nickel. . . .	. . . .	L. & N.	

	Positive current and caloric moving together (cold. + / hot. −)	Positive current and caloric moving in opposition. (hot. + / cold. −)	Remarks.
TIN . . .	. . . . .	T. & T.	
and			
Zinc. . . .	T. & Z.		
Gold. . . .	T. & G.		No effect with hot tin. The other combination very feeble.
Iron. . . .	. . . . .	I & T.	Hot tin no effect.
Mercury. .	. . . . .	1. T. & M. 2. M. & T.	No. 1. very feeble.
Nickel. . .	. . . . .	1. T. & N. 2. N. & T.	For No. 2. the nickel must be made red hot.
ZINC . . .	. . . . .	Z. & Z.	
and			
Gold. . . .	Z. & G.	Z & G.	No. 2. very feeble.
Iron. . . .	. . . . .	I. & Z.	Hot zinc no effect.
Mercury. .	. . . . .	1. M. & Z. 2. Z. & M.	
Nickel. . .			
GOLD . . .	. . . . .	G. & G.	
and			
Iron. . . .	I. & G.	I. & G.	No. 2. much more powerful than the other.
Mercury. .	. . . . .	1. M. & G. 2. G. & M.	These effects very indistinct.
Nickel. . .			
IRON . . .	. . . . .	I. & I.	
and			
Mercury. .	I. & M.	I. & M.	
Nickel. . .	I. & N.	I. & N.	
MERCURY .	. . . . .	M. & M.	
and			
Nickel. . .			
NICKEL. .	. . . . .	N. & N.	

Although this communication relates to the metals in their elementary state, there are several other substances, which, in consequence of their being good conductors, are capable of acting as powerful electromotors, both by heat and acids. Among these may be specified most of the iron ores holding the protoxide, the sulphuret of iron, charcoal, plumbago, &c. I found a specimen of the load-stone, in my possession, to possess this power to a much greater extent than many of the metals. These natural productions are distinguished by being, as far as my observation extended, *negative*, as to the current, with all the metals, not even excepting bismuth. The energy with which they act upon the galvanometer, by the contact of fluid matter, at once explains the fallacy of those recent experiments with this instrument, the object of which was to prove that galvanic currents exist in mines. Without denying the fact, it is obvious that those obtained, were the result, solely, of the *instrument* employed. For if we connect a disc of zinc with one wire of the galvanometer, while the other wire touches the moist iron ore, and then bring the zinc into contact with the fluid upon the ore, a current will result, which proceeds from the zinc alone, in consequence of its oxidation. I am inclined to the opinion, therefore, that these experiments, upon the strata of mines, admit of this explanation in all the cases hitherto noticed.

University of Virginia, Oct. 9th, 1833.

Art. IV.—*Motion of a System of Bodies*; by Prof. Theodore Strong.

Continued from p. 46, Vol. xxiv.

ANALYTICAL FORMULAE.

It will here be convenient to give the investigations of some analytical formulæ which will be wanted in the course of this paper.

(1.) To find an expression for the cosine of the angle made by any two straight lines, in terms of the angles which they make with three rectangular axes, x, y, z, drawn through any given point.

If the lines intersect; through their point of intersection, draw three straight lines parallel to x, y, z, then evidently the given lines will make angles with x, y, z, which are equal to those which they make with their parallels respectively. Take on each of the given lines a distance (from the angular point,) equal to unity=the radius of the trigonometrical tables; let one of these distances (for distinction,) be denoted by (1), the other by (1′); also let a, b, c, denote the cosines of the angles which (1) makes with the axes, x, y, z, severally, and a', b', c', the corresponding cosines for (1′); then a, b, c, are the orthographic projections of (1) on the parallels to the axes x, y, z, severally, and a', b', c' are the projections of (1′) on the same lines; (for the orthographic projection of one straight line on another, equals the line to be projected, multiplied by the cosine of the angle which the lines make with each other.) Let P=3.14159 etc. (=the semicircumference of a circle whose radius=1;) φ=the angle made by the given lines; then (1) projected on (1′)=cos. φ, but the projection of (1) on (1′) is evidently equal to the sum of the projections of a, b, c, on (1′); now the projection of a on (1′), $=aa'$, that of $b, =bb'$, and that of $c, =cc'$, $\therefore$ cos. $\varphi=aa'+bb'+cc'$, (a);

if $\varphi=0$, then cos. $\varphi=1$, $a=a'$, $b=b'$, $c=c'$, $\therefore a^2+b^2+c^2=1$, (b);
if $\varphi=\frac{P}{2}$, then cos. $\varphi=0$, $\therefore aa'+bb'+cc'=0$, (c).

If the given lines do not lie in the same plane, then through any point in one of them, draw a straight line parallel to the other, and the angle which these lines make with each other, is manifestly equal to that which the given lines make; hence, (a), (b), (c) may be found as before.

(2.) To change the rectangular coördinates of a point referred to one system of axes, to the rectangular coördinates of the same point, when referred to any other system of axes, having the same origin.

Let x, y, z, denote the coördinates of the point when referred to the first system, and x', y', z' its coördinates relative to the second system, also let L, denote the stright line drawn from the origin to the point; and let a, b, c denote the cosines of the angles which the axis of x, makes with the axes of x', y', z', repectively, and a', b', c', the corresponding cosines for the axis of y, also, a'', b'', c'' the cosines for the axis of z. It is evident that $x=$the projection of L on the axis of $x=$the sum of the projections of x', y', z' on the same axis: and the same remarks apply to y and z with respect to the projections of x', y', z', on their axes; hence $x=ax'+by'+cz'$, $y=a'x'+b'y'+c'z'$, $z=a''x'+b''y'+c''z'$, (d); in the same way $x'=$the sum of the projections of x, y, z, on the axis of x', and y', the sum of the projections on the axis of y', and so of z'; hence $x'=ax+a'y+a''z$, $y'=bx+b'y+b''z$, $z'=cx+c'y+c''z$, (e). It is evident by (b) and (c), and because the two systems of axes are rectangular, that we shall have $a^2+b^2+c^2=1$, $a'^2+b'^2+c'^2=1$, $a''^2+b''^2+c''^2=1$, $ab+a'b'+a''b''=0$, $ac+a'c'+a''c''=0$, $bc+b'c'+b''c''=0$, $a^2+a'^2+a''^2=1$, $b^2+b'^2+b''^2=1$, $c^2+c'^2+c''^2=1$, $aa'+bb'+cc'=0$, $aa''+bb''+cc''=0$, $a'a''+b'b''+c'c''=0$, (f); it is evident that (f) are only equivalent to six independent equations, so that three of the nine cosines which they involve are indeterminate. Again, (since by (f), $bc+b'c'+b''c''=0$, $1-c^2=c'^2+c''^2$, $1-b^2=b'^2+b''^2$,) we have $b^2+c^2=b^2+c^2-2bc(bc+b'c'+b''c'')=b^2(1-c^2)+c^2(1-b^2)-2bc(b'c'+b''c'')=b^2(c'^2+c''^2)+c^2(b'^2+b''^2)-2bc(b'c'+b''c'')=b^2c'^2-2bcb'c'+c^2b'^2+b^2c''^2-2bcb''c''+c^2b''^2=(bc'-b'c)^2+(bc''-b''c)^2=1-(b'c''-b''c')^2$; but $b^2+c^2=1-a^2$, $\therefore a^2=(b'c''-b''c')^2$ or $a=b'c''-b''c'$; also $b=a''c'-a'c''$, $c=a'b''-a''b'$, $a'=b''c-bc''$, $b'=ac''-a''c$, $c'=a''b-ab''$, $a''=bc'-b'c$, $b''=a'c-ac'$, $c''=ab'-a'b$, (g); it may be observed that the equation $a^2=$

$(b'c''-b''c')^2$ gives $a=\pm(b'c''-b''c')$, but the sign $-$ does not apply; for supposing the coördinates x, y, z to coincide with x', y', z', we have $a=1$, $b'=1$, $c''=1$, $b''=0$, $c'=0$; having determined the sign of a, the signs of b and c are also determined as in (g), for a, b, c, are to be taken so as to make $aa'+bb'+cc'$ (identically)$=0$; and in a similar way have the signs of a' b', &c. been determined as in (g).

x, y, z can be found in terms of x', y', z, in another manner: for brevity, and clearness, imagine (with La Place, Mec. Cel. Vol. 1, p. 58.) that the origin of the coördinates is placed at the centre of the earth, that the planes of x, y, and x', y' are the ecliptic and equator respectively, that the axes of z, z' are drawn to the north poles of the ecliptic and equator severally.

Let $\psi=$the angle made by the axis of x and the radius drawn to the vernal equinox, $\frac{P}{2}+\psi=$the angle made by the axis of y and the same radius, these angles being reckoned according to the order of the signs; put φ, $\frac{P}{2}+\varphi$ for the angles which the same radius makes with the axes of x', y' respectively, these angles being reckoned according to the direction of the earth's rotation about its axis; let $\theta=$the obliquity of the ecliptic$=$the angle made by the axes of z, z'. It is manifest that the sum of the projections of x, y, z on any straight line, equals the sum of the projections of x', y', z' on the same line; for each of these sums equals the projection of L on that line. Let the two systems of coördinates be projected on the line of the equinoxes, then (since the projections of z, z' are each$=0$,) we have x cos. $\psi+y$ cos. $\left(\frac{P}{2}+\psi\right)=x'$ cos. $\varphi+y'$ cos. $\left(\frac{P}{2}+\varphi\right)$ or (since cos. $\left(\frac{P}{2}+\psi\right)$ $=-$sin. ψ, cos. $\left(\frac{P}{2}+\varphi\right)=-$sin. φ,) x cos $\psi-y$ sin. $\psi=x'$ cos. $\varphi-y'$ sin. φ, $(h.)$ Again, let the two systems be projected on the line of the solstices, then (since the projection of $z,=0$,) we have x cos. $\left(\frac{P}{2}-\psi\right)$ $+y$ cos. $\psi=x$ sin. $\psi+y$ cos. $\psi=$the sum of the projections of x, y, z; also x' sin. φ cos. $\theta=$the projection of x', for it evidently equals the projection of x' on the line of common section of the solstitial colure (or plane of z, z',) and equator, projected on the line of the solstices; the first of these projections$=x'$ cos. $\left(\frac{P}{2}-\varphi\right)=x'$ sin. φ, and this projected on the line of the solstices gives x' sin. φ cos. θ as above; by changing x' into y', φ into $\frac{P}{2}+\varphi$, we have y' cos. φ cos. θ=to the projection of y'; the projection of z',$=z'$ cos. $\left(\frac{P}{2}-\theta\right)=z'$ sin. θ; hence $(x'$ sin. $\varphi+y'$ cos. $\varphi)$ cos. $\theta+z'$sin. θ=the sum of the projections of x', y', z',=the sum of the projections of x, y, z; $\therefore$ x sin. $\psi+y$ cos. $\psi=(x'$ sin. $\varphi+y'$ cos. $\varphi)$ cos. $\theta+z'$ sin. θ, (*i*.)

Lastly, let the systems be projected on the line of common section of the plane z, z' and equator: this is easily effected by (*i*,) viz. by changing x', y', z' into x, y, z severally, and x, y into x', y'; ψ into φ, and φ into ψ; (observing that the sign of the term involving z must be changed, for its projection$=z$ cos. $\left(\frac{P}{2}+\theta\right)=-z$ sin. θ; hence x' sin. $\varphi+y'$ cos. $\varphi=(x$ sin. $\psi+y$ cos. $\psi)$ cos. $\theta-z$ sin. θ, (*k*.) Multiply (*h*) by cos. ψ, (*i*) by sin. ψ, then add the products and (since cos.$^2\psi+$sin.$^2\psi=1$,) we have $x=x'$ (cos. θ sin. ψ sin. $\varphi+$cos. ψ cos. $\varphi)+y'$ (cos. θ sin. ψ cos. $\varphi-$cos. ψ sin. $\varphi)+z'$ sin. θ sin. ψ, *(l)*; change the multipliers into, – sin. ψ and cos. ψ; then (as before,) $y=x'$ (cos. θ cos. ψ sin. $\varphi-$ sin. ψ cos. $\varphi)+y'$ (cos. θ cos. ψ cos. $\varphi+$sin. ψ sin. φ) $+z'$ sin. θ cos. ψ, (*m*); substitute x sin. $\psi+y$ cos. ψ as given by (*i*), in (*k*); then (since $1-$cos.$^2\theta=$sin.$^2\theta$,) we have by reduction $z=z'$ cos. $\theta-y'$ sin. θ cos. $\varphi-x'$ sin. θ sin. φ, (*n*). (*l*), (*m*), (*n*) agree with the equations which La Place has given at p. 58. Vol. 1 of the Mec. Cel. and if I am not greatly mistaken they have been found by a much more simple method than his.

Now, since a, b, c, &c. ψ, φ, θ, remain the same for every point of space when referred to the axes of x, y, z, and x', y', z', $\therefore$by taking the point in the axis of x', we have $y'=0$, $z'=0$; hence (*d*) become $x=ax'$, $y=a'x'$, $z=a''x'$, and (*l*), (*m*), (*n*) become $x=x'$(cos. θ sin. ψ sin. $\varphi+$cos. ψ cos. φ), $y=x'$ (cos. θ cos. ψ sin. $\varphi-$sin. ψ cos. φ), $z=-x'$ sin. θ sin. φ;$\therefore$by comparing these values of x, y, z, $a=$cos. θ sin. ψ sin. $\varphi+$cos. ψ cos. φ, $a'=$cos. θ cos. ψ sin. $\varphi-$ sin. ψ cos. φ, $a''=-$sin. θ sin. φ, in a similar way $b=$cos. θ sin. ψ cos. $\varphi-$cos. ψ sin. φ, $b'=$cos. θ cos. ψ cos. φ $+$sin. ψ sin. φ, $b''=-$sin. θ cos. φ, $c=$ sin. θ sin. ψ, $c'=$sin. θ cos. ψ, $c''=$cos. θ, (*o*).

(3). Supposing the same construction and notation as before, let x, y, z, x', y', z', denote the rectangular coördinates of any element dm, of any given solid: then ψ, φ, θ, can be found so as to satisfy the equations $Sx'y'dm=0, Sx'z'dm=0, Sy'z'dm=0$, (p), S being the sign of integration relative to the mass of the solid. Let $\left(\frac{dz'}{d\psi}\right), \left(\frac{dz'}{d\theta}\right)$ denote the partial differential coëfficients of z', relative to ψ, θ, respectively; then by (e), (o), (h), (k), $z'=cx+c'y+c''z=(x \sin.\psi+y \cos.\psi)$. $\sin.\theta+z\cos.\theta$, $x'\cos.\varphi-y'\sin.\varphi=x\cos.\psi-y\sin.\psi=\frac{\left(\frac{dz'}{d\psi}\right)}{\sin.\theta}$, $x'\sin.\varphi+y'\cos.\varphi=(x\sin.\psi+y\cos.\psi)\cos.\theta-z\sin.\theta=\left(\frac{dz'}{d\theta}\right)$, (q); hence $x'=\sin.\varphi\left(\frac{dz'}{d\theta}\right)+\frac{\cos.\varphi}{\sin.\theta}\left(\frac{dz'}{d\psi}\right)$, $y'=\cos.\varphi\left(\frac{dz'}{d\theta}\right)-\frac{\sin.\varphi}{\sin.\theta}\left(\frac{dz'}{d\psi}\right)$, which give $x'y'=\frac{\sin.2\varphi}{2\sin.^2\theta}\left(\left(\frac{dz'}{d\theta}\right)^2\sin.^2\theta-\left(\frac{dz'}{d\psi}\right)^2\right)+\frac{\cos.2\varphi}{\sin.\theta}\left(\frac{dz'}{d\theta}\right)\cdot\left(\frac{dz'}{d\psi}\right)$, $x'z'=\frac{\sin.\varphi}{2}\left(\frac{d.z'^2}{d\theta}\right)+\frac{\cos.\varphi}{2\sin.\theta}\left(\frac{d.z'^2}{d\psi}\right)$, $y'z'=\frac{\cos.\varphi}{2}\left(\frac{d.z'^2}{d\theta}\right)-\frac{\sin.\varphi}{2\sin.\theta}\left(\frac{d\cdot z'^2}{d\psi}\right)$, (r). By assuming $Sx'z'dm=0$, $Sy'z'dm=0$, the second and third of (r) give $\left(\frac{d\cdot Sz'^2dm}{d\theta}\right)=0$, $\left(\frac{d\cdot Sz'^2dm}{d\psi}\right)=0$, (s), which are the conditions requisite to make $Sz'^2dm=$ to a maximum or minimum, supposing θ and ψ only to vary. By (q), $x'^2+y'^2+z'^2=x^2+y^2+z^2=L^2$, $\therefore S(x'^2+y'^2)dm=SL^2dm-Sz'^2dm$, but $SL^2dm=\text{const.}\therefore S(x'^2+y'^2)dm=$ a maximum when $Sz'^2dm=$ a minimum, and reciprocally; but $S(x'^2+y'^2)dm=$ the moment of inertia relative to the axis of z', $\therefore$ the second and third of (p) require (generally,) this moment to be a maximum or minimum. Put $Sx^2dm=g$, $Sy^2dm=h$, $Sz^2dm=k$, $Sxydm=g'$, $Sxzdm=h'$, $Syzdm=k'$; then by (q) $Sz'^2dm=\sin.^2\theta\,(g\sin.^2\psi+h\cos.^2\psi+2g'\sin.\psi\cos.\psi)+\cos.^2\theta\,k+2\sin.\theta\cos.\theta\,(h'\sin.\psi+k'\cos.\psi)$, (t).

By (s), making the partial differential coëfficients of Sz'^2dm relative to θ and ψ separately $=0$; we have $\sin.\theta\cos.\theta\,(g\sin.^2\psi+h\cos.^2\psi+2g'\sin.\psi\cos.\psi-k)+(\cos.^2\theta-\sin.^2\theta).(h'\sin.\psi+k'\cos.\psi)=0$, $((g-h)\sin.\psi\cos.\psi+g'(\cos.^2\psi-\sin.^2\psi))\sin.\theta+(h'\cos.\psi-k'\sin.\psi)\cos.\theta=0$, (u); substituting the value of $\cos.\theta$ from the second of these in the first, $[(g-h)\sin.\psi\cos.\psi+g'(\cos.^2\psi-\sin.^2\psi)]\times[(g\sin.^2\psi+h\cos.^2\psi+2g'\sin.\psi\cos.\psi-k).(k'\sin.\psi-h'\cos.\psi)+((g-h)\sin.\psi\cos.\psi+g'(\cos.^2\psi-\sin.^2\psi)).(h'\sin.\psi+k'\cos.\psi)]$

$=(h'\sin.\psi+k'\cos.\psi).(k'\sin.\psi-h'\cos.\psi)^2$, or $[(g-h)\sin.\psi\cos.\psi+g'(\cos.^2\psi-\sin.^2\psi)]\times[(k'g-h'g'-k'k)\sin.\psi+(h'k+k'g'-h'h)\cos.\psi]=(h'\sin.\psi+k'\cos.\psi).(k'\sin.\psi-h'\cos.\psi)^2$; put $u=\tan.\psi$, and we have $(h'u+k').(k'u-h')^2+((g-h)u+g'(1-u^2))\times((k'k+h'g'-k'g)u+h'h-k'g'-h'k)=0$, (v). Since (v) is a cubic equation, it has (by the theory of equations,) at least one real root; $\therefore u$ is a real quantity; $\therefore \psi$ becomes known, and thence $\tan.\theta$ is found by the second of (u); $\therefore \theta$ is known: having found ψ and θ, we can easily obtain φ, for multiplying the first of (r) by dm, taking the integral and putting $Sx'y'dm=0$, we have $\tan.2\varphi=-\frac{M}{N}$, M and N being known rational functions of $\sin.\psi$, $\cos.\psi$, $\sin.\theta$, $\cos.\theta$, g, h, etc. $\therefore \varphi$ becomes known; hence the position of the axes of x', y', z' is determined so as to satisfy (p); and it may be observed that the axes thus found are called the *principal axes* of the solid. It may be observed, that $u=\tan.\psi=$ the tangent of the angle made by the axis of x with the line of common section of the planes x, y, x', y'; but it is evident that (p) will exist if we change y' into z', and z' into y', that is, if we change the plane x',y' into x',z', and x',z' into x',y'; $\therefore (v)$ will give another value of u, which will be the tangent of the angle made by the axis of x with the line of common section of the planes x, y, and x', z'; and in a similar way it may be shown that (v) will give another value of u, which will be the tangent of the angle made by the axis of x with the line of common section of the planes x, y, y', z'; $\therefore$ the three roots of (v) are real, and they appertain, generally, only to one system of axes: hence a solid has, in general, but one system of principal axes passing through any given point. Again, if $Sxydm=g'=0$, $Sxzdm=h'=0$, $Syzdm=k'=0$, the axes of x, y, z will be principal axes: in this case, every term of (v) will $=0$, but (u) become $\sin.\theta\cos.\theta\,(g\sin.^2\psi+h\cos.^2\psi-k)=0$, $(g-h)\sin.\theta\sin.\psi\cos.\psi=0$, also $Sx'y'dm=abg+a'b'h+a''b''k=0$, (w); and (t) becomes $Sz'^2dm=g\sin.^2\theta\sin.^2\psi+h\sin.^2\theta\cos.^2\psi+k\cos.^2\theta=gc^2+hc'^2+kc''^2$, (x); also $S(x'^2+y'^2+z'^2)dm=S(x'^2+y'^2)dm+Sz'^2dm=S(x^2+y^2+z^2)dm=g+h+k=$(since $c^2+c'^2+c''^2=1$,) $c^2(h+k)+c'^2(g+k)+c''^2(g+h)+gc^2+hc'^2+kc''^2$, or by (x), $S(x'^2+y'^2)dm=c^2(h+k)+c'^2(g+k)+c''^2(g+h)$; put $h+k=A$, $g+k=B$, $g+h=C$, and we have $S(x'^2+y'^2)dm=c^2A+c'^2B+c''^2C$, (y). It may be remarked, that the first member of (y) is the moment of inertia relative to the axis of z', and that A is the moment relative to the axis of x; also B and C are the moments relative to the axes of y and z, and c^2, c'^2, c''^2 are the squares of the cosines of the angles which these axes make with the axis of z'; hence, generally, if we multiply the moment of inertia relative to each of the principal axes passing through any given point, by the squares of the cosines of the angles which they severally make with any other axis drawn through the same point, and add the products, we shall have the moment of inertia relative to that axis. If $g=h=k$, (w) become identical independently of the angles ψ, φ, θ, $\therefore$ every axis drawn through the origin of the coördinates is a principal axis; and by (x) $\mathrm{S}z'^2dm=g=$const. whatever may be the direction in which the axis of z' is drawn, $\therefore$ $\mathrm{S}(x'^2+y'^2)dm=2g$. If we put $\sin.\theta=0$, the first and second of (w) are satisfied, and the planes of x', y', and x, y coincide; also the axes of z' and z coincide; and by (o) a'', b'', c are each $=0$, $\therefore$ the third of (w) becomes $abg+a'b'h=0$, and by (f) $ab+a'b'=0$ or $a'b'=-ab$ $\therefore$ $ab(g-h)=0$, and by (f) $a^2+b^2=1$; these equations are satisfied by making $b=0$, $a=\pm1$ which make the axes of x', y' to coincide with those of x, y; the above equations are also satisfied by making $a=0$, $b=\pm1$, which indicate that the axis of x' coincides with that of y, and the axis of y' with that of x; on these suppositions we therefore have no new system of principal axes: but if $g=h$ the above equations are satisfied, and as a, b are indeterminate, every axis drawn through the origin in the plane x, y is a principal axis, and we have an infinity of systems of principal axes, the axis of z being common to them all.

Again, by (x) when $g=h$, $\mathrm{S}z'^2dm=g+c''^2(k-g)$; $\therefore$ $\mathrm{S}z'^2dm=$ const. in whatever direction the axis of z' may be drawn, provided it always makes a constant angle with the axis of z; $\therefore$ $\mathrm{S}(x'^2+y'^2)dm=$const. when the axis of z' makes a constant angle with the axis of z; also, (as before,) all the axes drawn through the origin in the plane x, y are principal axes. If no two of the quantities g, h, k are equal, then no two of A, B, C are equal; let A be the greatest and C the least of them, then (y) is easily put under the forms $\mathrm{S}(x'^2+y'^2)dm=\mathrm{A}-c'^2(\mathrm{A}-\mathrm{B})-c''^2(\mathrm{A}-\mathrm{C})=\mathrm{C}+c^2(\mathrm{A}-\mathrm{C})+c'^2(\mathrm{B}-\mathrm{C})$, which show that $\mathrm{S}(x'^2+y'^2)dm$ is less than A, and greater than C, whatever may be the direction in which the axis of z' is drawn; $\therefore$ A is a maximum, C a minimum, and B neither a maximum nor minimum. Put $x'=\mathrm{X}+{}_{,}x$, $y'=\mathrm{Y}+{}_{,}y$, $z'=\mathrm{Z}+{}_{,}z$, $m=$ to the mass of the solid, and suppose that X, Y, Z are the coördinates of the centre of gravity of the solid; then $S(x'^2+y'^2)dm = S({}_{,}x^2+{}_{,}y^2)dm+2XS{}_{,}xdm+2YS{}_{,}ydm+(X^2+Y^2)Sdm$, but $Sdm = m$, and by the nature of the centre of gravity $S{}_{,}xdm=0$, $S{}_{,}ydm=0$, hence $S(x'^2+y'^2)dm=S({}_{,}x^2+{}_{,}y^2)dm+(X^2+Y^2)m$, (z).

(z) will enable us to find the moment of inertia relative to an axis drawn through any given point when the moment of inertia is known for a parallel axis passing through the centre of gravity of the solid; it is also evident that the absolute minimum moment of inertia belongs to one of the principal axes which passes through the centre of gravity: see Mec. Cel. Vol. I. pp. 75, 76, etc.

It has been supposed in II. that the system revolves about a centre of force situated at the origin of the coördinates, but this is not necessary except for simplicity, for the origin may be taken at any point, (at pleasure,) provided all the forces are considered as disturbing forces.

Hence (11.) have place as before, (there being now supposed no centre of force at the origin,) and the invariable plane is found in the same manner; the areas $\frac{D}{2}$, $\frac{D'}{2}$, &c. being now rectilineal triangles instead of curvilineal sectors, but this does not affect the determination of the invariable plane. From what has been said, it is manifest that when the system is affected by no foreign forces, there will be a particular invariable plane for each point of space. Again (7) are easily changed to $Sm\left(\frac{xd^2y-yd^2x}{dt^2}\right)=Sm(Qx-Py)$, $Sm\left(\frac{xd^2z-zd^2x}{dt^2}\right) = Sm(Rx-Pz)$, $Sm\left(\frac{yd^2z-zd^2y}{dt^2}\right)=Sm(Ry-Qz)$, (18), where P, Q, R, P′, &c. are supposed to be the same as in (1), (2), (3) given at p. 40; for as at p. 42, $c=\frac{r^2dv}{dt}=\frac{xdy-ydx}{dt}$, &c. and by resolving Q and P at right angles to r, we have the resultant of all the forces which affect a unit of m when resolved at right angles to the extremity of $r=\frac{Qx-Py}{r}=T$, $\therefore Tr=Qx-Py$, and in a similar way $T'r'= Q'x'-P'y'$, and so on; $\therefore$ by substituting these values of c, Tr, c', &c. in the first of (7) it will be changed to the first of (18), and in a similar manner may the second and third of (18) be obtained from the second and third of (7). (18) can easily be found directly from (1), (2), (3); for multiply the first of (2) and (1) by x and $-y$, respectively, then add the products, and we have $\frac{xd^2y-yd^2x}{dt^2}=Qx-Py$, also $\frac{x'd^2y'-y'd^2x'}{dt^2}=Q'x'-P'y'$, and so on for all the bodies m, m', &c. Let a unit of m act on a unit of m' with any force p, then (by the well known law of equal action and reaction;) a unit of m' will react on a unit of m, with the force $-p$, which is directly opposite to p; hence $mp=$ the whole force with which m acts on a unit of m', and $-m'p=$ the whole force of the consequent reaction of m' on a unit of m; let f denote the straight line which joins m and m', then evidently the forces mp, $-m'p$ are exerted along the line f: hence by resolving mp in the directions of the axes of x and y, we have $\left(\frac{x-x'}{f}\right)\times mp$ and $\left(\frac{y-y'}{f}\right)\times mp$ respectively for the parts of P' and Q' which arise from the force mp, and $-\left(\frac{x-x'}{f}\right)\times m'p$, $-\left(\frac{y-y'}{f}\right)\times m'p$, are the parts of P and Q which arise from the force $-m'p$; hence, (for simplicity,) considering these forces only, we have $(Qx-Py)=\left(\left(\frac{x-x'}{f}\right)y-\left(\frac{y-y'}{f}\right)x\right).m'p=\left(\frac{y'x-x'y}{f}\right)m'p$, also $Q'x'-P'y'=-\left(\frac{y'x-x'y}{f}\right)mp$, $\therefore$ we have $m(Qx-Py)+m'(Q'x'-P'y')=0$: it is hence evident that if we multiply the equations $\frac{xd^2y-yd^2x}{dt^2}=Qx-Py$, $\frac{x'd^2y'-y'd^2x'}{dt^2}=Q'x'-P'y'$, &c. by m, m', &c. respectively, and add the products, we shall have $Sm\left(\frac{xd^2y-yd^2x}{dt^2}\right)=Sm(Qx-Py)$ which is independent of the reciprocal actions of the bodies on each other, for the mutual actions of every two of them will destroy each other as above; the equation which we have obtained is the same as the first of (18), and the second and third of (18) are easily found by a similar process.

(To be continued.)

Art. V.—*Of securing houses and their inhabitants from fire, and of obtaining supplies of water and of warm air.*

INTRODUCTORY LETTER TO PROF. SILLIMAN.

Sir—The respectable person to whom the following letter and postscript have been *anonymously* addressed, having, through a common friend, assented to the transmission of them to you, in order to be placed in the American Journal of Science and Arts, of which you are the Editor; they are now forwarded for that purpose, nearly in their original dress, except as to a few verbal alterations. An addition, however, has been made, of some amount, under the name of a *supplement;* which, from want of opportunity, has not been submitted to the same critical inspection; but which, nevertheless, I feel authorized to annex, after having made this statement on the subject. I am, sir, yours respectfully, ——— ———.

Hon. W. J. Duane, Secretary of the Treasury, Washington.

July 31, 1833.

Sir—Having noticed the accounts given to the public respecting the conflagration which lately took place in a portion of the buildings at Washington assigned to yourself, officially, as Secretary of the Treasury for the United States, various reflections have since occurred to me, on the subject of the conflagration of *buildings which are inhabited*, and on other *connected circumstances*. I presume, Sir, to submit some of these reflections to your consideration, through the medium of a friend, in the form of a letter. Should any statements or suggestions seem to require explanation, the use of the same channel will produce a reply. As I am anxious to live as a retired person, my friend is desired not to name me to you, a request with which he will doubtless comply.

My letter will first touch upon some *general points*, which respect the securing of inhabited buildings from fire, and will then proceed to some *miscellaneous remarks;* and be followed by a *postscript*, containing some *incidental matters*, which could not conveniently be introduced in the body of the letter.

1. For the prevention of *injury by fire among houses*, I may relate, that when I was once sitting alone with Dr. Franklin, over the embers of his hearth, he took occasion to remark upon the great

losses sustained by fires in England, compared with the small injury done by fires in France. He said, that this difference seemed to him to arise, chiefly, from the different modes of building (then) employed in the two countries, especially with regard to *stair-cases*, and to the *passages* between different sets of rooms; but he farther took into account, the contrast prevailing between the two nations in the fashion of *ornamenting* and of *furnishing* their houses.—He remarked as to the first point, namely, the *mode of building* in the two countries, that in England their *stair-cases* were commonly wholly of *wood*, running from the bottom of a house to its top, and that when a fire found its way to such a stair-case, it naturally spread in succession to every floor in the house, in consequence of the means of communication thus offered, (and especially, he might have said, where an *upward* draught of air assisted.) The Doctor then added, that it was a farther aggravation of matters, that *passages* of the same materials occurred to conduct the fire from room to room. He noted also, that the English had much superfluous wood-work in their houses, by way either of wainscoting or of ornament. In France, on the contrary, he remarked, that their *stairs* were so constructed, as to be in effect incombustible, including the railings;* and equally so their *passages* from one set of rooms to another set; and that in general their *floors* were formed of stucco, tiles, or other safe materials. He farther said, that where in their respectable houses a portion of their apartments had *wooden floors*, yet as the furniture of these apartments usually consisted solely of hangings or curtains, carpets, pictures, and other loose articles, these might easily suffer, without injury to the room containing them.—I may add to what Dr. Franklin thus stated, that though, in France, the *ceilings* of the rooms in *common* houses, and the ceilings of *garrets* in almost all houses, are (so far as I recollect) generally of wood, yet fire can seldom reach these *ceilings* from below; or, should it reach them, many of them would be found liable to little important damage, upon a *principle* to be mentioned under the next head.—To this head I shall immediately proceed, since Dr. Franklin's suggestions on our general question speak sufficiently for themselves, as to their application on the present occasion.

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* The construction of most of the stair-cases in France, (by an intermixture of wood-work, bricks and mortar, with iron railings,) is worthy of universal attention for certain situations, as being easily imitated at little cost, and of much importance in several points of view. Their stair-cases are sometimes made of stone, but never of wood alone, unless in the form of ladders.

2. Another means, then, of preventing the progress of fire in a building, is to render it difficult for the fire to make an *open* passage *through* the combustible substances which it attacks, *merely by having those substances closely lined behind with some material which resists fire.* By an attention to this simple rule, Lord Mahon (now Earl Stanhope) and Mr. David Hartley, (the person who signed the definitive treaty of peace between this country and Great Britain in 1783,) were able to cover with combustibles, in a flaming state, the floors of *whole rooms* and *whole stair-cases,* without injury to the buildings of which those rooms and stair-cases made a part; neither flame nor air being able to pass in this case *through* and *beyond* the substance of the wood-work *on which those burning materials rested.*—Lord Mahon succeeded in his object on this occasion, by placing mortar close below or behind his wood-work; and Mr. Hartley, if I remember well, accomplished his purpose by fixing sheets of iron in the same situations, closely connecting these sheets with each other. Experiments were publicly exhibited, with perfect success, on *each of these plans,* before numerous spectators of every rank; and if my memory does not deceive me, the well known Abbé Mann confirmed the efficacy of this practice by corresponding trials made in Flanders.—Here, then, we have a *second mode* offered to aid our attempts to preserve buildings from fire; concerning which mode various details, which are truly interesting, will be given in the postscript. It shall only be added in this place, that the principle of this new rule strongly operates, (as has been hinted above,) in favor of those wooden ceilings, in France, where the floors above them are composed of incombustible materials.

We now proceed to a *third expedient* of importance on these occasions, of a nature wholly distinct from any thing which has yet been mentioned.

3. Another particular, then, deserving attention as a guard against conflagrations, especially where an elevated building is concerned, is the establishment of *cisterns for holding water in different parts of such edifices;* which cisterns may receive their water, either from rain, or from any other convenient mode of supply.

This plan, in effect, was formerly proposed for one of the public theatres in London; and it has certainly been adopted for one of the buildings connected with the powder magazines at Purfleet in Essex, in England; and I am not sure that it has not been employed at the Capitol at Washington, since I know that this suggestion was once under the consideration of Mr. Bulfinch, the late national architect, with this view.—This resource, however, in order to be complete, should be accompanied with some very large *syringes*, for throwing water with precision, force and dispatch, into every quarter where water shall be requisite in case of fire.—It will be advisable also to attach, permanently, to every large edifice *a very small fire-engine;* and Mr. S. V. Merrick, of Philadelphia, has furnished such for only one hundred dollars each; a hundred feet of hose, (of a proportionate small diameter,) being added at a separate, but moderate, expense. One of these little engines has, under my own eye, been found to be particularly useful, as being quickly brought forth for use, and very readily managed; and it serves both for extinguishing fires at their earliest commencement, and also for keeping buildings wetted on their outsides, when exposed to the action of flames raging in a neighboring building. The small size and small weight of this engine will admit also of its being carried into court-yards, alleys and lower rooms; and it may even be hoisted into any of the windows of an upper floor, properly prepared beforehand for receiving it. In all cases, the use of one of these little engines will prevent the breaking up of the lines of persons who are occupied in handing buckets for the supply of the larger fire-engines, which ought to be occupied at great fires on more serious objects.*—More will be said in the postscript on the subject of cisterns and reservoirs for holding water to be used for the above purpose, particularly as *derived from rain*, (whether collected from the roofs of buildings or otherwise.)

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* The following addition may be considered as a note, in this place, to the original communication.

Establishments of various kinds have been made for supplying fire-engines with water. Sometimes, for example, pipes filled with water are laid under the pavement of the streets, and in mountainous countries open aqueducts are provided, from which, at fires, little pools of water are formed in the streets; each engine being furnished, by means of a leathern pipe of its own, with water, out of these pools.—Sometimes they have, as at Philadelphia, what they term a *hydrant*, to supply water under the operation of pressure, which, when wanted at a fire, is allowed to rush into leathern pipes or hose, under the direction of hose companies, to throw it upon buildings in flames; the same being imitated on a smaller scale in Boston.—Sometimes too water is thrown by forcing pipes into cisterns placed aloft in a building, as at Purfleet, in England; and they are able to do the same, with great ease, in Boston.—But still these expedients will not always supersede the use of *syringes* and of the *little engine* mentioned in the letter above. Nor perhaps will cisterns from *rain water*, placed in the upper part of a building, be always to be despised, whether as regards economy or convenience.

4. Some have proposed *to steep building timber in certain liquids,* in order to render it incombustible as to its exterior; but nothing having been sufficiently made known to the public, as to the efficacy of such a project, we may pass over this suggestion.—The same may be said of *chemical or other materials thrown among flames,* in order to extinguish them; particularly as articles of this kind cannot interfere with any thing proposed in this letter.—As to *iron beams, &c.* placed horizontally in buildings, however efficacious they may be supposed to be for attaining the general object here in question, yet they do not seem hitherto to have attracted public notice sufficiently to make it necessary to speak farther concerning them in this place.

Here, then, the enumeration of the particulars to be proposed, as to the mode of constructing *buildings,* so as to *prevent their taking fire,* or of *extinguishing fire* when it seizes them, will be concluded for the present.

My Miscellaneous Remarks are now to follow,—and they will chiefly regard different modes of introducing *warmth* into large buildings, or of excluding *cold* from them, as well as other particulars of a like description.

1. It is important, in a country subject to severe winters, to have *double doors* at each of the entries into a large building, with a certain *space between these doors,* by the aid of which the passages and stair-cases within the building may easily remain filled with warm air, which can, by various methods, be thrown into them.

2. *Double windows* may be equally useful during the winter, in a large portion of the United States. This and the preceding expedient are not named here because unknown in the United States, but because they are too generally neglected. Yet the utility of double windows, in particular, can be forgotten by none who have visited the north eastern parts of Europe in winter.—*Caulking* the edges of window-sashes in winter, is another precaution against severe cold, not to be despised.—And again, in countries like the United States, where habit so often leads to a *superfluity* of windows in some of their buildings, the closing of such windows as can be dispensed with during the winter months, (by shutters or other suitable means,) is a proceeding not to be overlooked.

3. Since *smoky* rooms are still disgracefully common in the United States, an anecdote as to one course which may be taken for curing them shall here be given. A celebrated naturalist in this

country, wishing to avoid this evil in a house which he was building, put together, in brick-work, out of doors, without mortar and with his own hands, the sides of the opening of a chimney, and also of its throat, according to Count Rumford's latest plan; and then directed his workman to set up these bricks, with the addition of mortar, in his house, in the same form and order in which he had himself placed them. This method being adopted for the chimnies of the whole building, not one room in his house was found troubled with smoke, on either floor; provided that on the first lighting of any of his fires, a piece of inflamed paper was put on the top of the lighted fuel, to direct the course of the flame up the chimney.

4. A safe place for *ashes* should be provided in every large inhabited building; and a most rigorous attention should be paid to enforce the constant use of it.—On the same principle, the *jambs* of a chimney should either be of marble, stone, or brick; or rest upon marble, stone, or brick; since if the lower part of these jambs be of *wood*, they may easily be set on fire by brands or embers, falling from the fire-place when no one is at hand to observe it.

5. The method of warming rooms by heat conveyed into them *through pipes*, is, in some form or other, generally known in the United States; but proper principles do not appear to be every where well established respecting the subject; as will appear from the following remarks, which have in fact all been called for by errors on this head, which I have myself noticed as having occurred in practice.—1. Where *metallic tubes* are employed on this occasion, they ought not to be so much heated, as to yield unhealthy fumes. 2. Pottery or brick work *with cavities in it*, however small, ought not to be employed for pipes; lest offensive particles should lodge in these cavities, and contaminate the air as it passes through them. 3. The *air admitted into these tubes* should be collected from a healthy quarter; and therefore not from cellars, or other damp or foul places; nor from within a house, and especially if drawn from the *level* of a dirty or dusty floor or carpet; but be obtained from the atmosphere at large by suitable means. 4. Methods for *cleansing* these air-tubes should be provided, lest spider's webs, or other obstructions or impurities should collect there in the summer season, and produce inconveniences of different kinds.

6. Nothing is said here of the newly invented modes of warming *green-houses and hot-houses*, by heat communicated to portions of air surrounding a set of metallic reservoirs, and corresponding metallic

pipes connected with them; each of these reservoirs and pipes being filled with warm water; for experience has not directed us to any convenient mode of conveying air thus warmed to the different apartments and passages of a house. Nor is it needful to speak of the introduction into our apartments of pipes containing water derived from *deep and powerful springs*, or obtained (as it might be in some cases) from *running streams;* in order to communicate to these apartments an inferior, but yet an useful degree of warmth. This warmth may indeed suffice for assemblages of active persons, (as in manufactories,) or for large collections of persons generally; but cannot furnish that comfortable amount of warmth, satisfactory either to individuals, or to small companies quietly seated in large apartments in cold countries.

7. It may be curious at least, if not useful, to notice some of the methods used by foreigners for warming themselves by means of fire.—First, there are *braziers*, (that is, open metallic pans,) containing heated materials, which are in use in countries where the cold is only *occasional;* but these more or less contaminate the air above them which is intended for respiration, at the same time that the heat from them is furnished in an inconvenient manner. Yet they may be of momentary use even in *cold* climates, when the air is chilly or damp; since they may easily be withdrawn, after having furnished some warmth to an apartment before its proper fire has been well kindled. Accordingly they are not unknown to some persons in the United States; the vessel containing the hot materials being formed of thin sheets of iron, of an oblong shape, open at the top, and resting upon slender iron legs; and being consequently easily moved from place to place by means of long handles formed with wire.—The *German stoves* (by the French called *fours*, or ovens,) are large cavities generally made of pottery and brick work, which advance through the side of a room, to a given distance into the room; being heated from without; and although they admit *no change of air in the room*, yet they seem to produce no great evil on this account to those using them; polluted air (*malaria*, as we may call it,) in general arising more from *vegetable* than from animal impurities. A good judge of statistics belonging to this country, is said to have discovered one advantage in the employment of these stoves among the Germans in Pennsylvania; namely, that they virtually produce *an economy of time* among these people, which has not a little contributed to their prosperity; inasmuch, as by the aid of these stoves, they are always able to continue at their work within doors,

without stopping to warm their limbs or their fingers.—The Russians adopt a still more coarse manner of warming themselves, without any apparent inconvenience; owing (as is well known) to their practice in this respect being counteracted by their vapor baths, by great peculiarities in their diet, and by their occasional access to pure atmospherical air, and perhaps by other circumstances in their habits not yet explained to us.—The French have *stoves*, (called *poêles*,) which admit of some little circulation of air; but the flue which carries away the smoke belonging to them, often requires to be guarded with the utmost attention, to prevent accidents from fire. These stoves, when formed of pottery with short flues, seem not unhealthy; and the vapor of hot water is thought to lessen this mischief, when they have bodies of iron and long iron flues.—In the London Philosophical Transactions, an account is given of stoves, as used by some of the Chinese.—In Capt. Cook's Third Voyage, (3,374,) we find, that the natives of Kamtschatska have a pit in the earth, roofed with turf, (resting on wood work,) for their *winter habitation*, with an open fireplace, and a vent above to let out the smoke; and they have likewise a *summer habitation*, raised from the ground, and resting on poles: a refinement, not known to some of their pretended superiors in civilization.—As the several contrivances mentioned in this paragraph are not *in general* suited to the manners of the inhabitants of the United States, who are for the most part attached to *open fireplaces and brick chimnies*, they call for no farther details here.

But it is time to conclude this part of my communication, by referring to what is necessarily, Sir, familiar to you; namely, to the fact, that since the first formation of man, there never was so urgent a necessity for establishing good *architectural principles*, as exists at the present moment in this country; whether we have in view *beauty*, or the still more important objects of *safety*, *convenience and comfort*, connected as these are with *ultimate economy*. The executive department of the federal government, while attending to these obvious points of its duty, will have the farther satisfaction of knowing, that whatever useful measures it can introduce in these respects into its proceedings, will not only have a happy influence on the citizens of this great Union, but not improbably attract attention from the great States which are now forming themselves in what is to be called a *new world*. I have the honor to be, with particular respect,

Sir, your very obedient servant,

—— ———.

POSTSCRIPT.

Some *detached matters* will now be touched upon, which have been reserved for this place, because admitting of a more convenient notice here, than in the body of my letter.

I. I begin then by introducing some additional particulars, which have been promised respecting the plans of *Lord Mahon* (now Earl Stanhope) and of Mr. *D. Hartley*, for *protecting buildings from fire.*

The statement of what regards *Lord Mahon* will be borrowed from the London Philosophical Transactions for 1778, Vol. 68, Part 2.

1. The first object of the communication here to be noticed, concerns a *wooden house*, constructed at Chevening in Kent, for the purpose of performing in it, "in the most natural manner," (as his Lordship expresses it,) *his experiments on the subject here in question;* and his Lordship speaks thus, respecting this part of his proceedings. "On the 26th of September, [1777,) I had the honor to repeat some of my experiments before the President and some of the Fellows of the Royal Society, the Lord Mayor and Aldermen of the city of London, the committee of city lands, several of the foreign ministers, and a great number of other persons. The first experiment was to fill the lower room of the building (which was about twenty six feet long and sixteen wide) full of shavings and faggots, mixed with combustibles; and to set them all on fire. The heat was so intense, that the glass of the windows was melted like so much sealing wax, and ran down in drops; yet the flooring boards of that very room were not burned through, nor was one of the side timbers, floor joists, or ceiling joists, damaged in the smallest degree; and the persons who went into the room *immediately over* the room filled with fire, did not feel any ill effects from it whatever; even the *floor* of that room being *perfectly cool* during that enormous conflagration immediately underneath."—So much for the *wooden house!* (*See p.* 892.)

2. His Lordship, having made, what we may call an *extemporary building*, for the purpose of having it fairly *burned throughout from top to bottom*, proceeds thus in his statement.—"I *then* caused a *kind* of wooden building (of full fifty feet in length, and three stories high in the middle), to be erected quite *close to* the end of the secured wooden house [above mentioned]. I filled and covered this building with *above eleven hundred* large kiln faggots, and several

loads of dry shavings; and I set this pile on fire. The *height of the flame* was no less than eighty seven feet perpendicular, from the ground; and the *grass* upon a bank, at a hundred and fifty feet from the fire, was all scorched; and yet the *secured wooden building*, quite contiguous to this vast heap of fire, was not at all damaged, except some parts of the *outer* coat of plaster-work.—This experiment was intended to represent a *wooden town on fire;* and to show how effectually even a wooden building, if secured according to my *new* method, would stop the progress of the flames on that side, without any assistance from fire-engines, &c. (*See, for this passage, p.* 892-893.)

3. His Lordship, in the last place, proceeds to mention his experiments as to a *small stair-case, in a confined place;* of which his account is as follows.—"The last experiment I made *that day*, was the attempt to *burn a wooden stair-case*, secured according to my simple method of *under*-flooring; the under side of the stair-case was extra-lathed. Several very large kiln faggots were laid and kindled, *under* the stair-case, round the stairs, and upon the steps: this wooden stair-case notwithstanding, resisted (as if it had been of fire stone,) all the attempts that were made to consume it. I have *since* made *five* other still stronger fires upon this same stair-case (without having repaired it;) having moreover *filled the small place in which the stair-case is*, entirely with shavings and large faggots; but, the stair-case is however still standing, and is but little damaged.—(*See p.* 893.)

Passing over the details of particulars as to the methods pursued by Lord Mahon, for securing his objects, with their cost, we shall now proceed to the *concluding paragraph* of his Lordship's paper; which is as follows. "I purpose giving to the world, before long, a detailed account of many *other* experiments I have made upon this subject; and of the various advantages arising from my method, with several particulars relative to the different parts of each of the methods above described; and relative to their joint or separate application to different kinds of building, and to the different constituent parts of a house;—to which I shall add, a full explanation of the *principles* upon which they are founded, and the *reasons* for their *certain and surprising* success. In the mean time, I have taken the liberty of troubling the society with this short account."

Thus far Lord Mahon.—I have not examined, however, whether his Lordship, (as promised) resumed this subject in any subsequent volume of the Philosophical Transactions; having had neither time nor opportunity for the purpose. But I may remark in general, as to what has been stated, that such is Lord Mahon's character, for veracity, sagacity, perseverance and precision, that his account may be thoroughly depended upon; farther sanctioned, as it is, by the tacit assent given to his statements by Sir John Pringle, then President of the Royal Society, and by the necessary inquiries of the Committee of Publications, of that respectable body on this subject. As his Lordship tells us, (p. 891,) that he had made "a prodigious number of experiments upon every part of his methods," it is unfortunate that we are not furnished with his *theory* on the subject in question, in his own words; since the extensive course of experiments in which he was engaged, must have furnished him with many *hints*, which he had an opportunity *either of confirming or of rejecting*.

We now proceed to Mr. D. Hartley, who I may here add, was son of the celebrated metaphysician, Dr. Hartley, and a person not wanting either in correctness or enthusiasm. His methods however on the subject here in question, must be considered as amounting to little more than a variation of those exhibited by Lord Mahon; who tells us in the title to his memoir, that *he* had *invented* the plan; which assertion, he twice confirms in the body of his memoir; and I have no recollection, of any counter claims, having occurred on this occasion.

Mr. Hartley operated upon a brick building, apparently well put together, and having at least two stories. It was situated on a common, near London; and the experiment was tried in the presence of a large assemblage of persons, among whom were many of high station and character. The registers of the day, doubtless give the details of Mr. Hartley's proceedings, and I myself can vouch for the following fact; namely, that any person riding past, some short time afterwards, could (from without,) discover no other injury done to the building by the operation which it had undergone, than that the brick-work above one or more of the windows, bore strong marks of the action of a fierce flame upon it; this flame appearing evidently to have issued from *within* the building.

We now take leave of these spirited and respectable experimenters, by saying, that we must not wonder after all their labors, that the good people of England, have not generally profited by what was thus twice brought under the view of their metropolis. This indifference, has been owing partly, to the difficulty of changing national customs, unless where fashion leads the way. But this obstacle has been very essentially increased in the present instance, by the facility and cheapness of insuring against fire, existing throughout England; by the many fire engines, distributed around the country, and particularly in the city of London; by the employment of wood-work both for wainscoting and ornament, having of late years been much lessened in the houses of the English; and by the number of houses which are built in England, on *speculation*, by persons with limited means, and which therefore are not likely to be constructed in a provident manner, if calling for any material increase of cost.—But this forms no objection to the adoption of proper principles in the construction of *stair-cases* and of the *passages* between different sets of rooms; any more than it does to the *banishment of wood-work* as much as possible from the *sides* of an apartment. The explanations therefore given above on these heads, are not to be considered as being without their use.

II. We now proceed to consider (as promised) the mode of supplying cisterns with water, for extinguishing fires in buildings, and particularly where the buildings are *very elevated*.

The *roof* of each building offers of itself one obvious source of supply of water on this occasion. If the climate affords only thirty inches of *rain* annually, (and in many parts of the United States, the quantity which falls annually is abundantly greater,) a superabundant supply of water falling in the shape of rain on any roof whatever, is here offered for a *demand which is only occasional*.—The cisterns containing this water, however, should not be too limited in number; for if made very large, and placed aloft in a building, the weight of each cistern would be so enormous, as to be dangerous; and convenience also will of itself suggest the propriety of placing these cisterns in several *different* places. They should be of *wood*, and of a *cylindrical* form, except that they should be *wider* at their tops, than at their *bottoms;* (that in case of frost, the water, when it expands into ice, may always rise into wider parts of the vessel, so as to avoid bursting it.) The water, also in order to be always sweet, should be introduced into the cistern, by *a pipe descending to the bottom;* for the water last entering will thence naturally occupy the lower part of the vessel, and by pressing up the water which preceded it, will create a sort of circulation so as to prevent the water's becoming offensive; a *spout* being placed at the top to carry off all superfluity.

Water may thus, always be found, at hand for the extinction of fire in the *upper part of a building*, however *elevated* it may be.—Whatever passes off by the spout may be conveyed to a new set of receiving vessels below, so as to increase at pleasure the stock of water *below*. If these lower receiving vessels be of *wood*, covered at top, and placed on the *ground* in a *warm aspect*, I have found by some experience, that frost in general is not likely to injure them; provided (as was hinted above) that the general form of these vessels be that of a *truncated cone*, with the base placed uppermost.—Should the cellar however be held as the more eligible place for receiving the surplus water, it may be preserved there in *tanks* of stone of any form, or of brick lined with a suitable mortar: but unless there be a *drain from the cellar*, more water should not be admitted there than is necessary for family uses.

Here we might quit the subject of the *artificial collection of water;* but perhaps a few additional words may be indulged to me on this subject, by way of extending the use of the hints here given, though what I am now about to offer is not specifically connected with the subject of *conflagration.*—I begin then, by remarking, that persons who live in portions of the United States, where the springs issue from a soil supposed to be unhealthy, or who reside in prairies or other places where there are so often no springs whatever; may collect *rain-water*, on a very extensive scale, not only by the means of the *roofs of dwelling* houses, but of those of *out-houses*, and even by the help of *paved surfaces* of the ground; the water in the latter case being made to enter into a *cess-pool* to deposit its impurities before it enters the reservoirs where it is to remain for use.—Rain-water is originally, the purest of all waters, and may serve for family use in various ways; but what is intended for *drinking* should be obtained from a part of the roof always kept clean with that very view; and if necessary, it may be preserved afterwards in vessels properly corked.—Water may also be collected thus for the use of *cattle*, as in Antigua; and this example may be imitated, in the case of *farms* which are remote from proper watering places.—If rain-water be required for the watering of *gardens*, especially on account of its *softness*, sheds in gardens will furnish roofs for collecting it; and as a last resource, paved surfaces of ground will supply unlimited amounts, at little cost or trouble.—Where water *descends from a roof*, it will in many instances be useless to confine it *within a pipe* in its *descent;* for it will rush down in floods on the outside of *solid*, *wooden*, *upright poles*, properly placed, especially if longitudinal *flutings* have been made in them by common tools; since the wind must be high indeed to prevent the water descending thus with great regularity in sufficient quantities for use.—I may add, that water, (to my knowledge,) has been carried for more than two thousand yards from an elevated spring, through a small *covered trough*, formed by loose bricks. These bricks are to be laid in part longitudinally, and in parts transversely, and to be surrounded, if necessary, with a coating of clay. The water which passes, must then be made to rest quietly in a great receptacle, that it may become clear, before it is drawn off for the services of a family in the different floors of a large mansion.

Such brick troughs indeed are said to subsist to this day, in the Levant, formed by the ancient Greeks, for similar purposes; which is a sufficient proof both of their utility and durability.—I have myself seen water in a suitable soil, running even in an *open channel*, through very great distances; and furnishing drinking places for animals remaining in their pastures, as it moved along.—In this enterprising age, water, we know, has been brought up from great depths, either by digging or by boring, to the gratification of a whole neighborhood; and we are encouraged to hope, that the bowels of the earth, by means of boring, may be made to supply water, in many places, to the thirsty desert, for the use of caravans and their attendant animals.—*Shipping* also, may avail themselves of the resource of *rain*, when stopped at any time, in a place where good water is not at hand, by spreading large sails on shore for this purpose, in the mode well known to seamen, the water being received in casks, to be used, when the vessels go to sea again, for different useful purposes.—But enough of this digression, which, though, it will shew that water may be collected with ease both from the *air* and from the *earth*, yet has certainly nothing to do with *conflagrations;* a subject to which I am bound to return for a few moments.

III. It is reserved then, as a last article for this postscript, to state that *conflagrations* in buildings of almost all descriptions, may arise from *lightning*. But, in truth, the formal provision against such an accident, does not lie so much in the general *construction* of our buildings, as in their *position*, and in *contrivances* to be superadded to their *exterior*.—On the latter subject, we may state, that it is not yet *universally* agreed, what those measures ought to be. In 1772 and 1777, when two successive committees of the Royal Society gave their opinion as to the mode to be used for protecting the powder magazines at Purfleet, against lightning, every thing was suggested with a view to the *very peculiar localities of that establishment;* all express pretensions to abstract rules, *as such*, being studiously avoided.—It cannot therefore, be expected, that any thing on this head, should be said here in a *concise* manner, with an expectation of its being satisfactory. It is a poor consolation on this occasion to be able to affirm, that there is perhaps no one subject in meteorology, which has had justice done to it in all its branches; and therefore, that what regards lightning does not seem to form an exception to the general rule. Persuaded however, as I myself am of this fact, I do not conceive that the subject can be properly discussed in all its parts, unless in a separate little memoir; and here therefore, I must take my leave of it at present.

[The *supplement* to this paper will be found either at the *close* of this number, or the *commencement* of the next.]

Art. VI.—*Observations on architectural, rural, domestic, and other improvements;* by Eleazar Lord, of New York.

New York, July 23, 1833.

TO PROFESSOR SILLIMAN.

Sir,—I observed recently, in one of the public prints, a brief notice of an association of gentlemen in your city, for the purpose of ascertaining and recommending the best plans and models of domiciliary architecture. The questions to be investigated relate, as near as I remember, to the architectural proportions, materials for building, and methods of warming and ventilating apartments, by which durability, economy, and convenience, may be combined with elegance and taste.*

These, in every point of view, are questions of great interest. They concern not only the thrift and comfort of individuals and families, but likewise the health, the social character, and indirectly, the morals of households and communities; and, considered in these relations, they are worthy of all the attention they can receive from enlightened and philanthropic citizens. It is matter of wonder that they have not hitherto gained that hold on the public mind to which they

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* Many other objects were embraced in the plan.—Ed.

are entitled; and no less a matter of satisfaction, that they are now to receive notice in a city where there are so many advantages of location, scenery, knowledge and taste, for their elucidation, combined with right notions of economy, and of all the means of individual and social well being.

But my object in thus taking the liberty to address you, is to suggest, on presumption that you take a part in the proceedings of the association, that the enquiries to be pursued should be extended to some other topics, not less essential to the main design than those which have been announced; or rather that they should commence at an earlier point, and embrace what relates to the kinds of soil on which human habitations ought to be erected, and the choice of localities for that purpose considered in relation to neighboring formations and objects.

Without pretending to do more than to glance at some of the most obvious heads of enquiry under this branch of the subject, I may illustrate what I have in view, by a brief statement of questions which require investigation.

1. What are the chief requisites in a site for a dwelling house?

What circumstances and advantages are desirable, considered simply in relation to the principal design and use of the building; and what, considered in relation to adjacent objects?

2. What descriptions of soil are proper for the sites of dwellings?

What soils are to be preferred for yards, gardens, and adjoining grounds?

What soils are objectionable on account of their natural composition, or their liability to excessive moisture, or other vicissitudes?

3. What kinds of earth are to be preferred for cellars, considered in respect to moisture, temperature, and effects, in different seasons, on vegetable substances, and on the air in the apartments above?

4. What objects in the vicinity are in all cases to be avoided? Among these may be specified:

Marshes and all permanent receptacles of decaying vegetable matter.

Grounds which are periodically overflowed.

Grounds which are excessively wet from ordinary rains during a portion of every year, and which exhibit extensive evaporation.

Ponds which are drained in the course of the summer or autumn; and other

Localities which are occasionally subject to great changes in their condition, and in their influence on the atmosphere.

5. What considerations are to be taken into view in the choice of sites in given cases, as of plains, valleys, hills, mountains, banks of rivers, exposure to winds and storms, particular geological formations?

6. What considerations are to be regarded, in given cases, respecting the depth of cellars, the elevation of the first floor from the level of the adjacent grounds, and the position, height, and form of houses, reference being had to the position of other dwellings, and to that of out-buildings, gardens, roads, streets, and distant scenery, and to exposure to winds, storms, cold and heat?

7. What, with relation to dwellings and to each other, should be the position of barns and other out-buildings?

8. What cautions ought to be observed in the location and construction of dwellings and out-houses to guard each and all of them against the hazard of fire?

9. What plans and measures are to be adopted respecting door-yards, courts, gardens, shrubbery, vines and trees?

10. What is to be aimed at in respect to water for household use, and in what cases are pumps or aqueducts to be preferred to wells and fountains?

11. What plans and materials for fences are to be preferred?

12. What plans and materials are most eligible for walks, intended to be dry, durable, and tasteful?

These and the like heads of enquiry, would give scope for the most valuable instruction and advice, applicable to every part of our country, and which would, one cannot doubt, be extensively well received, adopted and carried into practical effect.

Of the thousands and tens of thousands who every year engage in the erection of dwellings, how few possess or are in any condition to obtain the knowledge which is needful to guide their judgments in respect to the most essential of the above particulars, or with a view either to economy, convenience, durability, elegance, health, security from fire, effect on price, or any other advantage, private or public? In how many thousands of instances, even in localities which present, to an informed and observant eye, unobjectionable sites, are all these benefits lost, and great inconveniences and evils incurred for want of such hints and advices as might be comprised in a tract of a few pages? In numerous cases, both of single dwellings and of neighborhoods it would seem that no one of these advantages could have been so much as aimed at or taken into account; and what is perhaps, somewhat more surprising, when a site has once been chosen and occupied, the most painful experience of its evils, the loss of health and of life itself, seldom causes it to be abandoned.

These observations might be illustrated by reference to insulated houses, and to villages and even cities. The public mind is not impressed with the considerations which ought to be had in view in the location of habitations; and in numberless cases, individuals blindly follow bad examples, or are determined by some whim, or some circumstance foreign to the real and permanent benefits to secure which ought to be their object. Each one, especially in the country and new settlements, builds his house when, how and where he pleases, as though his successors and the public had no concern with the matter, and as though the erection of a shelter for his family in a position and by a process which should least interfere with his present convenience and employments, were all that behoved him to take into account.

Hence it is common to observe houses placed where they should not be, though in the immediate vicinity of eligible sites, while the barns and out-buildings are so near to them and to each other, as to be objectionable on many accounts besides being all liable to be destroyed by fire in case of the burning of either of them.

Houses are likewise frequently built in low and damp situations where draining is impracticable, while the barns pertaining to them are placed, where the dwellings should be, on dry and advantageous locations. In numerous instances likewise, houses are to be observed not only on the borders of ponds and marshes, but on the side of them which is opposite to that whence the prevailing wind proceeds.

It were easy to multiply references of this kind; but the subject demands more particular and thorough investigation, and it is of such general concernment that I should suppose the association besides extending its field of enquiry, might well enlarge its plan in another respect so as to procure corresponding members, or associations, in different parts of the country and of the world, to co-operate with the primary body, and to publish in your excellent Journal and in the form of occasional tracts or otherwise, with drawings or cuts, the facts, principles and advices, which such a combination of means would furnish, and which are so universally needed.

Such an association branching itself out, and engaging the attention of numerous individuals, might exert a most salutary and effective influence, directly upon the subjects to be treated of, and through them on the health and enjoyments, and indeed on all the personal and social interests of man. That influence would be important in its connection with our moral and political economy, would essentially aid other reformations, would augment the resources of domestic interest and recreation, promote a taste for rural scenery and a love of excellence in every thing, add to the cheerfulness and beauty of dwellings, and prompt to the cultivation of the minds and hearts of their inmates. The bearing of such an influence on the subject of temperance, in very numerous instances of dwellings placed in unhealthy situations, is sufficiently obvious; and likewise its tendency to prevent indolence, pauperism and vice, and consequently, to diminish the hazards and burdens which one portion of every community imposes on another and better portion. He who is neat and tasteful in and around his dwelling, will be likely to cultivate those qualities of mind and heart, which such a state of things implies and requires; and will promote the same associations and habits in his family, and extend them, to the literary, moral and social education and conduct of his children. A portion of such families, in each small community, would by their sentiments and example raise the general standard of opinion and taste, and exalt these arrangements of elegance and comfort into rules of social observance, and requirements of decent propriety.

No such reformation however, of the opinions, tastes and habits of mankind, is to be hoped from individual or insulated effort. Reason and argument in such a case will be ineffectual, unless combined with personal and local influence. The threefold cord of association is the indispensable and only adequate instrument of success in an undertaking of this nature; and for the same reasons, even this instrument must be present and locally operative in every vicinage and community where its beneficial results are to be expected.

Nor is the design capable of being so easily or speedily accomplished, in any way, as to render unnecessary an extensive organization. Though many of the most important suggestions to be made require no very labored investigation, and among those who comprehend them, scarcely admit of two opinions; yet there are questions to be resolved respecting the location and structure of dwellings almost as numerous as the varieties in the surface of the earth and the wrong notions and habits of those who occupy it: questions which demand extensive enquiry and observation, and which will not be exhausted while any thing remains unknown of earth or air injurious to human health and happiness. The subject involves the physical nature, circumstances and wants of man, and in no slight degree his welfare as a rational, social and accountable being; it has an important relation to his plans, employments and success in life, and indeed to his whole history; it is to be studied in all its relations to nature and art, its relations to what is uniform and unalterable in the earth, to the various changes which are taking place in the surface, to various local peculiarites, to the increase and decay of vegetable matter, and the neglect or progress of cultivation, to changes in the course and deposits of streams, to the condition of natural and artificial collections of water, to climate and to the long catalogue of local, periodical and epidemic diseases.

A general reformation of the opinions and tastes of mankind, in respect to this whole subject is greatly to be desired as a means of temporal happiness. No small proportion of the self-procured and the hereditary misery and degeneracy of the race proceeds from ignorance and neglect of what is every where practicable in relation to this subject.

Who that closely inspects the sites, plans, materials, and condition of all the habitations in any district of country, or in any town or city, and the character, habits, pecuniary circumstances, pursuits, recreations, and enjoyments of their respective occupants, but must be forcibly struck with the powerful and discriminating effects of the causes which are involved in this field of enquiry? Who that traces the progress of an individual from his infancy in a mean, filthy, and ill situated abode, to one that is desirable for its location, structure and other advantages, can fail to perceive the operation of these causes?

Of how many both of the best and the worst members of society, may it not be said, that the influence of such causes on their natural dispositions and tastes, determined their course above or below the level on which they started? I remember an anecdote, related to me by the late Rev. Doct. Strong, of his ancient preceptor Doct. Bellamy, who, on parting with two of his pupils, by way of caution and advice to them, indicated, as what he had dreamed, his impressions, founded no doubt on what he had observed of their capacities, tastes, and habits, respecting their future career. The rising progress of one he traced to a thriving and beautiful parish, a handsome and commodious dwelling, and subsequent usefulness and honor.

The other he followed from one thriftless and quarrelsome parish to another, till he reached the poorest and most desolate section of New England. He afterwards visited the first at his residence in Hartford, and the other in a wretched tenement, surrounded by ragged children, in a parish which could boast only of such a minister, with no meeting-house, no school, and scarce a single entire glass window.

But there are other and far more important consequences to be looked for, than those which relate merely to temporal comfort and prosperity; consequences which involve the intellectual and immortal interests of men. And in that improved and cultivated state of society which the scriptures teach us to expect, when the present causes and occasions of degradation and sorrow will be resisted and overcome, when the evils we endure will be obviated by the Divine blessing on a wise and proper exertion of our faculties, this reformation will be universal and complete.

There is then every encouragement of growing and ultimate success to cheer those whose part it is to promote this object. And there surely are not wanting those in every place, who by their education and circumstances are qualified to take a part in it, and who by a common effort may soon do much for its advancement.

Let such fancy to themselves a town or village in a location free from all material objections, and possessing every essential advantage, and laid out and built in such a manner as to secure all the objects, public and private, which are desirable; let it be supposed that the benefits of such an arrangement are appreciated by the inhabitants, and that they agree in their tastes and opinions on this subject; and can there be any more doubt of the good effect of such a state of things on all the interests, character and welfare of the families concerned, than of the actual difference between the worst and best sites, buildings and occupants, in towns as they now exist?

Let them also consider what evils might be easily obviated, and what benefits secured, in their own immediate neighborhoods, by the improvements which attention to this subject would suggest; and to what more useful or creditable purpose their talents, knowledge, and leisure can be applied.

The subject may fitly be commended to the attention of Lyceums, and other existing institutions in different parts of the country, with particular reference to their respective localities.

With great regard, I remain your obt. st.

Eleazar Lord.

Art. VII.—*On the Fur Trade, and Fur-bearing Animals.*

TO PROFESSOR SILLIMAN.

Sir,—Deeming the fur trade one of our national interests, and presuming that many of its valuable details are unknown to most of your readers, I send the following sketches relating to the trade, and to fur-bearing animals; which, if they can be admitted into yonr Journal, may be found both interesting and useful.*

The skins of animals were employed for clothing from the earliest periods; "coats of skins" having been given to our first parents, even before their expulsion from Eden. As the human race grew numerous, the supply was deficient; and when the southern latitudes became inhabited and men formed societies, and lived in fixed habitations, civilization developed ingenuity and taste, devising various fabrics of wool, linen and silk. These were of every variety of form and pattern, rivalling the rainbow in hues, and ornamented with resemblances of every object of beauty. They were also light and cool, adapted to the sunny skies of southern and middle Asia. The vallies of the Euphrates and Tigris, and of the Nile, as well as Syria and Mesopotamia, were early occupied by highly civilized nations, enjoying the luxuries of manufactures and arts. It was principally the natives of northern and mountainous regions, and their immediate borders, who were habitually clad in furs, and skins; except those horsemen shepherds, who, wrapped in furs, traversed the immense steppe on the north of the Aral, Caspian, and Euxine seas, including the intervening range of the Caucasus, and extending west to the mouth of the Danube. These barbarians, under "the name of Scythians," occasionally forced the mountain passes and ravaged the plains of Mesopotamia and Syria. Their hostile incursions opened the way to a commercial intercourse, and in the progress of time the manufactures of Babylonia and Persia were exchanged for the horses, cattle and *furs*, brought by these savages from the forests on the north of "the treeless plains" of Scythia.

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* I am indebted to Mr. Aikin's paper on fur and the fur trade, published in the Transactions of the Society for the Encouragement of Arts, Manufactures and Commerce, 1830, London; and to several intelligent merchants of New York, for much of the information contained in the following article.

The first notice on record, of furs being employed for ornamental works is in the book of Exodus, where the artificers under the direction of Moses, made hangings for the tabernacle, of badger skins and ram skins dyed red,* and it appears from the apocryphal book of Judith, as quoted by Mr. Aikin, that furs were used by the princes of Babylon as an article of state and luxury; "soft skins being laid on the ground in the manner of Persian carpets, for Judith to sit and eat upon," and these were furnished for her use by the chamberlain of Holofernes.†

Historians and poets represent the rude warriors and hunters of antiquity, as clothed in furs, and skins, when fighting and hunting were the chief occupations of men. Virgil describes Æneas with an outer garment of Lion's skin, when he departed from Troy, and Alcestes as "formidably clad in the skin of the Lybian bear."‡

The use of furs for clothing was denied to the Jews by the Mosaical enactments; but Babylonia and Persia cherished a taste for them as articles of ornament and utility, while "the Greeks esteemed them badges of rusticity and barbarism," and the Romans held them in abhorrence.||

In a district of Babylonia, a certain species of small fur-bearing animals was found, which Ælian, who wrote in A. D. 110, says "were brought by traders to Persia, and sewn together into garments remarkable for their warmth," and Zonaras writes that Sapor "king of Persia, possessed a tent made at Babylon, in party work, of different colors, of the skins of animals, natives of that country."

But the Romans inhabiting the soft climes of southern Italy, associated with the idea of furs, those sons of rapine who invaded their frontiers; and their poets and historians, strengthened the prejudices of the people, by descriptions of the appearances and practices of those barbarian robbers. The emperor Augustus banished the poet Ovid to a fortress on the south shore of the Danube, near its principal mouth. He spent some of the last years of his life in that painful exile, and employed his time in composing epistles to his friends at Rome, describing in thrilling accents, the rude climate, and the ruder inhabitants of that tract of country which borders the north west coast of the Black Sea. Troops of those "horsemen shepherds" enveloped in furs, their long beards and hair matted with ice,

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* Exodus 39, 19.
† Judith 12, 15.
‡ Virgil, lib. v.
|| Aikin.

crossed the sea and river which are frozen in winter to a considerable extent; set fire to the houses, drove off the cattle, and either massacred or made captives of the inhabitants. To the Romans enjoying the security and luxuries of the metropolis, a hairy cloak might well be associated with ideas of disgust and dread, from the accounts given by the terrified poet, of those fur clad marauders.* Tacitus, in describing the most barbarous of the German tribes, says, "the Fenni are like wild beasts, without arms, horses, or homes; their food is the wild herb, *their clothing skins*, their resting place the ground." The poet Claudian too, relating a victory won over the Getae who had penetrated Greece, says, "the furred youth are mown down, their waggons swim in gore:" and in another poem he satirizes the minister Rufinus, for appearing on the seat of justice wrapped in fur; in imitation of, or in compliment to, his body guard of Scythians. The whole northern and eastern frontier of the Roman Empire was occupied by warlike and savage tribes, whose ordinary covering was of furs, except near some of the garrisons, where they had been taught the use of cloth, by long intercourse with the Romans.†

When these barbarians had established themselves in Italy, they laid aside the coarser skins which had been essential to protect them from the cold of Sarmatia and more northern climates, and adopted the light and beautiful fabrics "of Gallic and Italian looms;" but they still retained their taste for the fine and more costly furs, which they employed for ostentatious luxury rather than convenience or warmth.

The choice and precious furs had been held in high esteem among the nobles of Persia, many of whom were of Scythian origin, although the climate did not render them essential, as in Scandinavia and Sarmatia. The rich and rare furs were obtained through the medium of commerce, to minister to their love of display and personal distinction.

In the 6th century furs became an article of commerce in demand at Rome, where they had so lately been held in abhorrence. The dreaded barbarians who had taken possession of the imperial territory, transplanted their own usages and tastes upon the enervated metropolis.

Sables were brought to Rome from the countries on the Baltic, and from the mountainous regions near the head waters of the Eu-

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* Aikin. † Idem.

phrates, and Tigris, between the Euxine and Caspian seas; and large quantities of small furs came through the Greek merchants of the Crimea, or by the commerce of Cappadocia.

Of these, there were probably many varieties. The writers of that age term them, "Pontic, Babylonian, and Armenian mice." The only kind which can now be identified is the Ermine, which takes its names from Armenia, the place where it was then taken, and is thence called Armenian or Ermine.*

It is obvious that the fashion, and the high value placed upon furs, in the milder climates of Europe and Asia, were derived from the savages of the northern regions, who inundated the plains and vallies of the south; and when no longer needing their customary defences against the severity of seasons, still retained their attachment to their primitive customs so far, as to ornament the lighter products of the loom with the richest and most beautiful, while they discarded the shaggy and coarser kinds of fur.

Charlemagne wore a cloak of otter skins, and "a surcoat with sleeves furred with vair and fox." Octher, a Norwegian chief, states, that "the tribute paid to the Swedes, by the Fynnes, was skins of Marternes, reindeers, and bears." The Anglo Saxons cherished an attachment to furs in common with the other nations of German and Scandinavian origin; but they were confined to the products of their own country, except as they could by illicit traffic, obtain some of the rarer kinds from the northern, and other piratical traders.

In the middle ages the value of furs was at its zenith, and when they became of the highest fashion in the European courts, the expense of procuring the finest and richest, required a regal revenue. The precious quality of the ermine, the small size of the animal, and the supply required for the princes and nobles of Europe, rendered its cost enormous. Stephen de la Fontaine, master of the robes to Louis IX of France, charges "for three pieces and a half of velvet to make a surcoat, a dress mantle, and a hat lined with ermines, for the king against the feast of the star. For the said surcoat, a *fur lining* of three hundred and forty six ermines. For the sleeves and wristbands sixty. For the frock three hundred and thirty six; in all, seven hundred and forty six ermines for a single dress."†

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* Tranactions Soc. Arts, Com. &c. Aikin on furs.

† Aikin, Trans. &c. &c.

The four noble furs were "the sable, the ermine, the vair and the gris." The three first were admitted into armorial bearings. "Ermine is represented in Heraldry, by a white ground, with small black lengthened spots. The vair was a squirrel with a dove colored back, from Hungary and the southern provinces of Russia, and when blazoned was azure.* The sable is a rich dark color, between black and brown, with a tinge of olive, and in heraldry was the black color, in the arms of princes and nobles. The gris was probably a squirrel, but antiquaries are not confident to which variety it belonged.

In the first crusade, in 1097, the most sumptuous display on record was made before the Emperor Alexius Comnenus, at Constantinople. That city had not been overrun by the barbarians who desolated the countries of southern and western Europe. It was the last resort of arts, of law, of letters, of elegance and refinement; the strong hold of civilization. Here those martial devotees, the crusaders, descendants of the Goths, amazed at the splendors of this almost oriental city, caught the graces of an accomplished and polished people, and engrafted upon their own primitive tastes every congenial improvement. The canon, Albert, describes in glowing colors, the splendid vestments of purple, the cloth of gold, the robes of ermine, the mantles of furs, of martin, gris, and vair, which the crusaders displayed in the court of the Emperor. It was more than three hundred years from this era, before this resplendent city felt the withering arm of the Turk.† In 1453, Mahomet II., in the insolence of victory gave it over to pillage. After the work of desolation was completed, and rapine and cruelty had done their worst, he entered the ruined palace of the Constantines, and exclaimed, in the language of the Persian poet, "the spider may weave his web in the prince's palace, and the owl may sing his watch song on the towers of Afrasiah."

For many centuries the furs of ermine and sable were among the insignia of royalty, and the use of them was regulated by sumptuary laws. They were denied to the common people, and permitted to none but kings and princes, with a few exceptions in favor of distinguished nobles, certain state dignitaries, and the presiding magistrates in the high courts of justice. They were not blazoned in heraldry as mere ornaments, but as discriminating marks of high quality. They were associated with the poetry and chivalry of the age; and with

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* The skins of vair were imported from Hungary, according to Guill Le Breton.

† See Dearborn's Memoir on the Commerce of the Black Sea.

tournaments and heraldry lasted in high glory for three centuries; and then declined together on the introduction of fire arms. Mailed knights in their resplendent coats of arms were only the more conspicuous marks for shot, and the stern compulsion of an improved military system, caused a revolution in all the aspects of that era. The chieftain's banner gave way to the national flag; and the men at arms and the feudal retainer, were replaced by a mercenary soldiery. Silk also began to gain an ascendancy over furs, as it was more readily and gracefully accommodated to the capricious vagaries of fashion, and better adapted to the light and flowing draperies of dress and furniture than furs, which though rich, were often too heavy for all climes and seasons.*

Although "the noble furs," sable, ermine, gris and vair, claimed precedence, yet in the eleventh century the fur of the minever or mink, an amphibious animal from Russia, became a fashionable edging for the robes of gentleman, and the richer of the middling classes.

Previous to the direct trade in furs, established by Sir Richard Chancellor between England and Russia, they were brought from the north east through the ports of Livonia to the Hanse merchants, on the south coasts of the Baltic, and thence were distributed throughout Europe.† The Livonian trade was conducted in a mode so circuitous and with such suspicious policy, that it was known by very few where the furs were procured. The Livonian war induced the Czar, to open a direct trade, at the request of the merchants of England, through Sir Richard Chancellor, who discovered a passage around the North Cape to Archangel, in 1553. An English company, protected by the Czar, established several posts on the White Sea, with a warehouse at Moscow, whence they sent trading parties to Persia, and the countries on the Caspian. They exported silks and woollens, and received furs among other exchanges in return. The country bounded on the west by the Dwina, which falls

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* Mr. Aikin says, that "silken plush and velvet was probably invented in imitation of furs."

† In the eleventh and twelfth century, furs were the common coverings of beds, in the middle and west of Europe, besides forming the principal and most distinctive part of dress. The more precious furs were reserved for kings, knights and the principal nobility. Persons of inferior rank contented themselves with the vair or Hungarian squirrel, and the gris or gray; the lower orders of citizens, and burgesses, with the common squirrel and lamb skins. The peasants wore cat skins, badger skins, &c. *Notes to Fabliaux, or Tales of the twelfth and thirteenth century.*

into the White Sea on the north, extending east to the Uralian mountains, furnished sables, marterns, beavers, foxes, white and black minks, ermines, graies, and wolverings. The finest sables and black foxes came as tribute from the Samoieds near the mouth of the Oby. Dr. Fletcher, in describing the fur trade of Russia in 1558, enumerates, "black, dun, red and white foxes, sables, luzernes, martrones, (*martins*) gurnestalles or armines, minever, beaver, wolverine, grey and red squirrels, and the water rat:" and adds that "beside the quantity spent in the country, there are transported out of it by the merchants of Buccharia, Persia, Turkey, Georgia, Armenia and some parts of Christendom, to the amount of 500,000 rubles. The ruble being equal to two ounces of silver." The sable at that date, doubtless, held the highest rank at the Russian court, as "the Czar's crown was lined with a fair black sable, worth forty rubles, and his garments were of rich tissue and cloth of gold, furred with very dark sables." The Czar sent presents of sables, lysernes, and other beautiful furs to Queen Mary, and Queen Elizabeth, but Queen Elizabeth soon prohibited the wearing of any but native furs within her dominions; and although the trade had flourished, it began to decline, and was soon abandoned.

Since the conquest of Siberia, by the emperor of Russia, in 1640, the inhabitants of those interminable wilds, from the Uralian mountains to the Pacific Ocean, pay an annual tribute of furs to the czar. One skin out of every forty is delivered by the natives, to the agents of the different commissariats, and Kamschatka, and the Kurile islands afford no inconsiderable part of the precious revenue.

The mountains of Kamschatka are rich in fur-bearing animals of the most valuable kinds.* Bears, wolves, reindeer, argali or mountain sheep, otters, beavers, lynxes and foxes of every variety are found in the greatest plenty. Sables are abundant and also the fiery red fox, the finest of the species.

Immense quantities of fur are sent from Siberia to China, but the choicest kinds, the precious ermine of Yakutsk, the brilliant fiery foxes, and the best sables, are taken to Moscow and Novogorod, for the use of the princes and nobles of Russia, Turkey and Persia.

The discovery of Hudson's Bay and the river St. Lawrence, opened a new field of immeasurable extent, for the trade in furs. The

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* Cochrane's Trav. De Lesseps, &c.

French seized it with avidity, and the English were not slow in availing themselves of this new source of wealth, brought to light by their countryman. The advantage of water conveyance by the St. Lawrence and its immense tributaries, and by the lakes, which like a chain of inland seas, intersect the whole country from Lower Canada to the head waters of the McKenzie, gave a ready access to the deepest solitudes, which for thousands of miles had never been invaded by the footsteps of civilized man.

The French obtained a great amount of furs and peltry from their trading posts on the St. Lawrence, and throughout the region near the head waters of the Mississippi.* After they lost possession of Canada in 1762, the trade fell principally into the hands of the English and Scotch.

The Hudson's Bay Company was at first but a handful of private adventurers. They were incorporated in 1670, but had neither the capital nor the enterprise of the French, nor did they for many years accumulate as large an assortment of furs.

In 1775, Joseph Frobisher explored the region between Lake Superior and Lake Winnipeg, from which country vast amounts of valuable furs were obtained.

In 1783, another association called the North West Company, was formed for the purpose of exploring and appropriating, if possible, the territory between Lake Winnipeg and the Rocky mountains. McKenzie, one of the agents of this new company, discovered in 1793, the river which bears his name, and left to the geographer some of the most valuable data respecting those then unknown regions.

The avidity of trappers and fur traders on the American continent, is by no means confined to foreign or incorporated companies. Individuals and company adventurers, spread over the whole tract of unsettled country, from Bhering's straits to the mouth of the Rio del Norte, pursue the object through incredible hardships.

The Pacific Fur Company, established by Mr. Astor of New York, for the prosecution of the trade on the Columbia river, was

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* Peltries are skins merely dried as they come from the hands of the hunters. The same skins converted on the inner side into leather, by an aluminous process, without removing the fur, are called furs, and the art of dressing them is called furriery. In a stricter meaning, peltry comprises all skins covered with short hair, such as the deer, elk, buffalo, &c. principally manufactured into leather. In a general sense, furriery includes all skins dressed into leather, with the hair or fur on.

† McKenzie's Journey to the Arctic Ocean.

arranged with consummate skill, and promised unlimited success. It was his intention to send a ship annually from New York with provisions and goods for the Indian trade, and the same ship was to take the produce of the year's trade to Canton, dispose of the furs, and return to New York freighted with the products of China.

In procuring information which might be of unquestionable authenticity, I have been so fortunate as to receive from Alfred Seton, Esq. of New York, some important particulars respecting the state of the trade on the North West coast; and I am happy to give the following detailed account of the origin and dissolution of the Pacific Fur Company, in the language of that gentleman, who was himself an eye witness of the facts he recounts.

"The most extensive enterprise of its kind from the United States, and one which experience has since proved would have had the most advantageous results, was conceived by the vigorous mind of John Jacob Astor, and carried into effect in the year 1809.

By the organization of the old North West Company, the clerks, after serving an apprenticeship of seven years, for an annual small compensation, and an equipment, (one or two suits, blankets, &c.) then became candidates for a participation in the profits of the company; and until they became partners, their salary was increased to £100 per annum, and an additional equipment. The indentures of the clerks expired faster than vacancies occurred in the wintering partner's department, and when these did occur, some lacked interest to become partners, the great object of their ambition. The consequence was, that there were many of these elder clerks, of great experience in the Indian trade, who became dissatisfied with their situation, and were ready to listen to any overtures, by which their knowledge and energy might be more beneficially used for their own advantage. Four or five gentlemen of the above class entered into the views of Mr. Astor, and the result of this great commercial undertaking, (which time has since proved, would have made Mr. Astor, probably, the wealthiest individual in the world,) has shown, that in the selection of these gentlemen, a fatal error was committed; for if the active agents had been Americans, whose feelings, sympathies and connections, were identified with the success of our country, and whose interests pointed singly, to the successful establishment of the company, the difficulties which the war opposed to its prospects, would have been combatted, and these past, the wealth which that region of country has since poured into the coffers of the Hudson's

Bay Company, would have had its legitimate destination, viz. the reward of the man, whose energetic mind conceived, and opened at great risk, this new channel of national wealth.

"Mr. Wilson P. Hunt, of St. Louis, Mississippi, was the gentleman selected by Mr. Astor, to be the leader of the expedition, and to represent him at *Astoria;* he and one or two of the other partners, left Montreal with his engagés, in July 1809, by the way of New York and St. Louis, for the Columbia River; and the party arrived there in detachments after various mishaps and sufferings, during the winter of 1812. The ship Tonquin left New York early in the fall of 1810, with several of the wintering partners, a number of clerks, and engagés for the Columbia River. Among the partners was Mr. McDougall, who in the absence of Mr. Hunt from Columbia River, was to represent Mr. Astor there; this ship arrived safely in Feb. 1811, and this party selected a location and built a fort which they named Astoria. The ship Beaver left New York in the month of Nov. 1811, and arrived at Col. River in May, 1812, also with another party of clerks, and engagés. The different wintering parties were then organized, under the charge and guidance of the partners, and proceeded in one *brigade* to the forks of the Columbia River, and there separated, each detachment for the district of country which had been assigned to them, in the council of partners at Astoria, in which council it had also been decided, that Mr. Hunt should, in furtherance of other views connected with the company, embark on board the ship Beaver, and proceed to the Russian establishment at Norfolk sound, where his business being dispatched, he should be relanded in the fall at Astoria, by the Beaver, on her way to the Sandwich Islands and Canton. Mr. Hunt sailed in the Beaver, in the beginning of July; but instead of being again at Astoria in the fall, circumstances beyond his control, compelled him to proceed to the Sandwich Islands, and the company were left in ignorance, not only of his fate, but also of that of the ship. The news of the war reached Mr. McDougall at Astoria, on January 17, 1813, (the writer of this being one of the party bearing this information, by express, from the Rocky mountains.) The fort, at this time, was certainly ill off, both for provisions and goods, and as the war did not allow the company to hope for a vessel in the spring, all trade for furs with the natives was suspended, and detachments sent off in different directions to look for their living. During the winter, Messrs. McDougall and McKenzie, two of the former clerks of the North West Company, and the only partners at Astoria, had come to a determination to dissolve the company and abandon the country, and an express was sent off early in the spring to the wintering partners in the upper country, Messrs. Stuart and Clark, informing them of this determination, and urging them to take measures, viz. to trade horses, procure provisions, &c. to carry it into effect. These gentlemen, however, had been in too good a beaver country, and had succeeded in procuring too many furs, to come in too hastily, to the proposed measures. They reached Astoria from their wintering grounds with their detachments, on the 13th of June, 1813, bringing with them one hundred and ten packs of beaver aud other furs. Their fears of the non-arrival of the annual ship were realized, and what was of more consequence, there were no accounts of Mr. Hunt. They found encamped at Astoria, Mr. McTavish of the North West Company, with ten or twelve men, who had arrived there in the beginning of April, from Lake Winnipeg, and who had brought into the country the news of the war between the two governments. As the wintering partners had taken no measures to abandon the country, the lateness of the season compelled the postponement of this measure for another year, and the different wintering brigades were sent to their respective districts, not with the view of procuring furs, but to look out for the means of living. The writer of this left Astoria on the 1st of July, with two hunters and fifteen men, for the river Wollamut, (the Multnomah of Lewis and Clark,) which disembogues into the Columbia, about sixty miles above Astoria. The country bordering on this river is diversified with beautiful prairies and hills, where oak, maple, ash, and cedar abound; in the bends are cotton wood bottoms, where the elk resort in numerous herds, as the deer do on the hills and prairies. The natives (Calipuyaws) are peaceable; and fur-bearing animals, particularly the beaver, plentiful. A dozen of hunters, in this country, could have procured a sufficiency of provisions in four months, to have lasted the whole party a year. The small brigade mentioned above commenced hunting on the 5th of July, and by the 4th of August, besides supplying themselves most abundantly, they dispatched for Astoria a canoe load of thirty three bales of dried deer's meat. On their arrival at the fort on the 8th of August, things were going on much more smoothly than they had hitherto done, owing to the recent marriage of Mr. McDougall, with Comcomoly's (the old Chinook chief) daughter;—an unexpected step, when compared with his recent declaration, of his intention to abandon the country. Mr. Hunt arrived at Astoria, a few days subsequently to this, viz. on the 26th of August, in the ship Albatross, from the Sandwich Islands, where he had passed the last year. There were none other of the wintering parties at Astoria, than Mr. McDougall; and Mr. Hunt, after remaining there only six days, reëmbarked on board the same ship, for the purpose of procuring supplies for the company at the Sandwich Islands. Early in the month of October, of the same year, 1813, Mr. McTavish of the North West Company, with another partner, viz. Mr. Alexander Stewart, seven clerks, among whom was Mr. Ross Cox, (who had formerly belonged to the American Company, but had joined Mr. McTavish in his previous visit in the spring,) forty men, and nine canoes, made their appearance at Astoria. These were accompanied from above in another canoe, by Mr. John Clark, of the American party. The proclaimed object of the North West gentlemen, was to establish the country and drive out the Americans; and this insignificant party, (insignificant as it respects their means to effect their purpose,) conducted themselves in a haughty and supercilious manner, at their encampment, under the very guns of the American fort, in which there were sixty men. The British standard floated in every passing breeze, while at Astoria, no similar display was permitted. No loyal son of America, had the keeping of its stripes and stars. A single whisper in the ear of Comcomoly, from the American chief Mr. McDougall, would have sent these *gens du nord* to join the ages which are gone, so completely were they in the power of the Americans.

An extract of a letter from Mr. Angus Shaw, (an agent of the North West Company, and uncle of the American chief Mr. McDougall,) was read to the clerks convened for the purpose, in which it was stated, that "an English frigate was to be dispatched to destroy every thing American on the north west coast," and a few days subsequently to this, the goods, furs, establishments, and existencies of all kinds, in the country, belonging to Mr. Astor, passed into the possession of the North West Company. On the 30th of November, of the same year, his Britannic Majesty's sloop of war Raccoon, Capt. Black, having on board Mr. Jno. McDonald, a proprietor of the North West Company, arrived at Columbia River. On her appearance off the bar, Mr. McTavish, with all the furs, started up the river to secure them, uncertain of the character of the sail in sight; this method of placing beyond the reach of an enemy, this valuable description of property, appeared to have escaped the memory of the gentlemen, while the property belonged to Mr. Astor. The captain and officers of the sloop of war were sadly disappointed, at hearing that all the furs, &c. had two months previously, become the effects of loyal Englishmen. They had fed their fancies with hopes of large prize money; and when their investigations left not a loop to hang a doubt on, that their hopes were futile and baseless, their lengthened and rueful visages showed the extent of their disappointment. All that was left for the representative of his Britannic Majesty to do, was to take possession of the country in his royal master's name, which was accomplished with the usual ceremonies, and ci-devant Astoria received the royal appellative of Fort George.*

One circumstance occurred on the arrival of this ship, which puts beyond question, the ability to have held the fort and possession of Mr. Astor in the country for him, provided his agents had been so minded. Old Comcomoly was well aware of the distinction between Americans and Englishmen. Their trading ships had visited his country before a settlement had been thought of. He knew of the war, from his almost daily intercourse with the fort. When the *big war canoe* of the English arrived, he offered his entire band to exterminate the enemy who had come to make the Americans slaves. He showed this to be a feasible undertaking, for the ship could not approach within six miles of the fort; and the nature of the country, woods to the water's edge, would have concealed them completely from an attacking foe, and permitted them in perfect security to themselves, to have destroyed every individual that would land with hostile intent. The proposition, of course, was not accepted by Mr. McDougall, for reasons which have been made apparent.

The Raccoon left the river in the beginning of the year 1814; and on the last day of February, of the same year, Mr. Hunt returned to the river, with supplies, &c. for our relief, in the brig Pedler, which vessel he had bought at the Sandwich Islands for this purpose. His arrival was too late; the property no longer belonged to Mr. Astor; his old associate, Mr. McDougall, was a partner of the North West Company, and all that Mr. Hunt had to do, was to get the bills for the paltry sum this property had been sold for, and remit the same by some of the partners going across the country to Mr. Astor, in New York. This accomplished, he with two or three of the American clerks, embarked on board the Pedler on Saturday after-

* Restored to the United States by the Treaty of Ghent.

noon, 3d of April, 1814, and then bade a final adieu to the Columbia, the scene of many an exciting incident.

On board the Pedler were the captain and some of the crew of the ship Lark, which vessel, notwithstanding the war, Mr. Astor had dispatched for Columbia River, from New York, in March, 1813. She was unfortunately shipwrecked near the Sandwich Islands, and vessel and cargo entirely lost. This circumstance shows the deep interest Mr. Astor took in this enterprise, and had he met with that reciprocal singleness of purpose, which he had a right to look for, that source of national wealth would not have been lost to the country, as now it is; for the Hudson's Bay Company, which was united with the North West Company, in 1821, came into peaceable possession of all those parts, extended their posts, north, east, south and west, and with them, their influence over the Indians, which time, and that only, can do away with."

The Hudson's Bay and the North West Companies, always competitors, and generally angry rivals, after they were united in 1821, abandoned Astoria, and built a large establishment sixty miles up the river, on the right bank, which they call Fort Vancouver, where they now carry on an active and prosperous trade. They are humane and attentive to settlers, encouraging them both with assistance and protection, but they are extremely jealous of any interference or participation in the fur trade, and monopolize it from the coast of the Pacific to the mountains, and for a considerable extent north and south.

I am informed by Mr. Seton, that Mr. Astor obtains no more furs direct from Columbia river. His principal establishment is now at Michilimackinac, and he receives his furs from the posts depending on that, and from those on the Mississippi, Missouri, Yellow Stone, and the great range of country extending thence to the Rocky Mountains.

Ashley's Company from St. Louis, trap for themselves, and drive an extensive trade with the Indians; and a company of one hundred and fifty persons from New York, formed in 1831, under Capt. Bonneville, of the United States army, bring a considerable quantity of furs from the region between the Rocky Mountains and the coasts of Monterey and Upper California, on the Buona Ventura and Timpenagos rivers.

The fur countries from the Pacific east to the Rocky Mountains, are now occupied, (exclusive of private combinations, and individual trappers and traders,) by the Russians, on the north west from Bhering's strait to Queen Charlotte's Island in N. Lat. 53°, and by the Hudson's Bay Company thence, south of the Columbia river, from which Ashley's Company, and that under Capt. Bonneville take the remainder of the region to the coast of California. Indeed, the whole compass from the Mississippi to the Pacific ocean is traversed in every direction. The mountains and forests from the Arctic sea to the gulf of Mexico, are threaded, through every maze, by the hunter. Every river and tributary stream, from the Columbia to the mouth of the Rio del Norte, and from the McKenzie to the Colorado of the west, from their head springs to their junction, are searched and trapped for beaver.

Almost all the American furs which do not belong to the Hudson's Bay Company, find their way to New York, and are either distributed thence for home consumption, or sent to foreign markets.

The Hudson's Bay Company ship their furs from their factories of York Fort, and from Moose river on Hudson's Bay; their collection from Grand river, &c. they ship from Canada; and the collection from Columbia river goes to London. None of their furs come to the United States, except through the London market.

The *export* trade of furs from the United States, is chiefly to London. Some quantities have been sent to Canton, and some few to Hamburgh; and an increasing export trade in beaver, otter, nutria, and vicunea wool, prepared for the hatter's use, is carried on with Mexico. Some furs are exported from Baltimore, Philadelphia, and Boston, but the principal shipments from the United States, are from New York to London, from whence they are sent to Leipzic, a well known mart for furs, where they are disposed of during the great fair in that city, and distributed to every part of the continent.

The United States *import* from South America, nutria, vicunia, chinchilla, and a few deer skins; also fur seals from the Lobos Islands, off the river Plate. A quantity of beaver, otter, &c. are brought annually from Santa Fee. Dressed furs for edgings, linings, caps, muffs, &c. such as squirrel, gennet, fitch skins, and blue rabbit, are received from the north of Europe; also coney and hare's fur, but the largest importations are from London, "where is concentrated nearly the whole of the North American fur trade."*

Of the fur-bearing animals, "the precious ermine," so called by way of preëminence, is found, of the best quality, only in the cold re-

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* Aikin on Furs, Trans. &c.

gions of Europe and Asia.* Its fur is of the most perfect whiteness, except the tip of its tail, which is of a brilliant shining black. With these black tips tacked on the skins, they are beautifully spotted, producing an effect often imitated, but never equalled in other furs. The ermine is of the genus Mustela, (weasel,) and resembles the common weasel in its form; is from fourteen to sixteen inches from the tip of the nose to the end of the tail. The body is from ten to twelve inches long. It lives in hollow trees, river banks, and especially in beech forests; preys on small birds, is very shy, sleeping during the day, and employing the night in search of food. The fur of the older animals is preferred to the younger. It is taken by snares and traps, and sometimes shot with blunt arrows. Attempts have been made to domesticate it; but it is extremely wild, and has been found untameable.

The sable can scarcely be called second to the ermine. It is a native of northern Europe and Siberia, and is also of the genus Mustela. In Samoieda, Yakutsk, Kamschatka, and Russian Lapland, it is found of the richest quality, and darkest color. In its habits, it resembles the ermine. It preys on small squirrels and birds, sleeps by day and prowls for food during the night. It is so like the martin in every particular except its size, and the dark shade of its color, that naturalists have not decided whether it is the richest and finest of the martin tribe, or a variety of that species.† It varies in dimensions from eighteen to twenty inches.

The rich dark shades of the sable, and the snowy whiteness of the ermine, the great depth, and the peculiar, almost flowing softness of their skins and fur, have combined to gain them a preference in all countries, and in all ages of the world. In this age they maintain the same relative estimate in regard to other furs, as when they marked the rank of the proud crusader, and were emblazoned in heraldry: but in most European nations, they are now worn promiscuously by the opulent.

The martins from Northern Asia and the mountains of Kamschatka are much superior to the American, though in every pack of

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* An animal called the stoat, a kind of ermine, is said to be found in North America, but very inferior to the European and Asiatic.

† The finest fur, and the darkest color are most esteemed, and whether the difference arises from the age of the animal, or from some peculiarity of location is not known. They do not vary more from the common martin, than the Arabian horse, from the shaggy Canadian.

American martin skins there are a certain number which are beautifully shaded, and of a dark brown olive color, of great depth and richness.

Next these in value, for ornament and utility, are the sea otter, the mink, and the fiery fox.

The fiery fox is the bright red of Asia; is more brilliantly colored and of finer fur than any other of the genus. It is highly valued for the splendor of its red color and the fineness of its fur. It is the standard of value on the North Eastern Coast of Asia.*

The sea otter which was first introduced into commerce in 1725, from the Aleutian and Kurile Islands is an exceedingly fine, soft, close fur, jet black in winter with a silken gloss. The fur of the young animal is of a beautiful brown color. It is met with in great abundance in Bhering's Island, Kamschatka, the Aleutian and Fox Islands, and is also taken on the opposite coasts of North America. It is sometimes taken with nets, but more frequently with clubs and spears. Their food is principally lobster and other shell fish.

In 1780 furs had become so scarce in Siberia, that the supply was insufficient for the demand in the Asiatic countries. It was at this time that the sea otter was introduced into the markets for China. The skins brought such incredible prices, as to originate immediately several American and British expeditions to the northern islands of the Pacific, to Nootka Sound, and the North West coast of America, but the Russians already had possession of the tract which they now hold, and had arranged a trade for the sea otter with the Koudek tribes. They do not engross the trade, however; the American North West trading ships procure them, all along the coast, from the Indians.

At one period, the fur seals formed no inconsiderable item in the trade. South Georgia, in South lat. 55°, discovered in 1675, was explored by Capt. Cook in 1771. The Americans immediately commenced carrying seal skins thence to China, where they obtained the most exorbitant prices. One million, two hundred thousand skins have been taken from that island alone, and nearly an equal number from the island of Desolation, since they were first resorted to, for the purposes of commerce.†

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* The fiery fox from Asia is known at the Leipzic fair, as the Padolian fox.

† See Weddell's voyage towards the South Pole.

The discovery of the South Shetlands, S. lat. 63°, in 1818, added surprisingly to the trade in fur seals. The number taken from the South Shetlands in 1821 and 1822, amounted to three hundred and twenty thousand. This valuable animal, is now almost extinct in all these islands, owing to the exterminating system adopted by the hunters. They are still taken on the Lobos islands, where the provident government of Monte Video restrict the fishery, or hunting, within certain limits, which insures an annual return of the seals. At certain seasons these amphibia, for the purpose of renewing their coat, come up on the dark frowning rocks and precipices, where there is not a trace of vegetation. In the middle of January, the islands are partially cleared of snow, where a few patches of short straggling grass spring up in favorable situations; but the seals do not resort to it for food. They remain on the rocks not less than two months, without any sustenance, when they return much emaciated to the sea.*

Bears of various species and colors, many varieties of the fox, the wolf, the beaver, the otter, the marten, the racoon, the badger, the wolverine, the mink, the lynx, the musk-rat, the wood-chuck, the rabbit, the hare and the squirrel, are natives of North America.

The beaver, otter, lynx, fisher, hare, and raccoon, are used principally for hats, while the bears of several varieties, furnish an excellent material for sleigh linings, for cavalry caps, and other military equipments. The fur of the black fox, is the most valuable of any of the American varieties, and next to that the red, which is exported to China and Smyrna. In China the red is employed for trimmings, linings, and robes, the latter being variegated, by adding the black fur of the paws, in spots or waves. There are many other varieties of American fox, such as the grey, the white, the cross, the silver, and the dun colored. The silver fox is a rare animal, a native of the woody country below the falls of the Columbia river. It has a long, thick, deep lead-colored fur, intermingled with long hairs, invariably white at the top, forming a bright lustrous silver grey, esteemed by some more beautiful than any other kind of fox.†

The skins of the buffalo, of the Rocky mountain sheep, of various deer, and of the Antelope, are included in the fur trade with the Indians, and trappers of the north and west.

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* See Weddell's Voyage towards the South Pole.

† Lewis & Clark's Travels to the Rocky mountains, &c.

Fox and seal skins are sent from Greenland to Denmark.* The white fur of the arctic fox and polar bear, is sometimes found in the packs brought to the traders by the most northern tribes of Indians, but are not particularly valuable. The silver-tipped rabbit is peculiar to England, and is sent thence to Russia and China.†

Other furs are employed and valued accordingly to the caprices of fashion, as well in those countries where they are needed for defences against the severity of the seasons, as among the inhabitants of milder climates, who being of Tartar or Sclavonian descent, are said to inherit an attachment to furred clothing. Such are the inhabitants of Poland, of Southern Russia, of China, of Persia, of Turkey, and all the nations of Gothic origin in the middle and western parts of Europe. Under the burning suns of Syria and Egypt, and the mild climes of Bucharia and Independent Tartary, there is also a constant demand, and a great consumption, where there exists no physical necessity. In our own temperate latitudes, beside their use in the arts, they are in request for ornament and warmth during the winter, and large quantities are annually consumed for both purposes in the United States.

From the foregoing statements, it appears that the fur trade must henceforward decline. The advanced state of geographical science shows that no new countries remain to be explored. In North America, the animals are slowly decreasing from the persevering efforts and the indiscriminate slaughter practised by the hunters, and by the appropriation to the uses of man of those forests and rivers which have afforded them food and protection. They recede with the aborigines, before the tide of civilization, but a diminished supply will remain in the mountains, and uncultivated tracts of this and other countries, if the avidity of the hunter can be restrained within proper limitations. With great respect, I am, &c.

New York, November, 1833.

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* Crantz's Greenland.

† Mr. Aikin states, "lamb skins are imported by England" (for consumption there) "from Russia, and are of the four following varieties, black wavy from Astracan; black curly from the Ukraine; gray curly from the Crimea; gray knotty from Persia."

Art. VIII.—*Additional remarks on the Agave and other plants, from which ropes, twine, and thread, are made;* by James Mease, M. D., and H. Perrine, Esq.

Philadelphia, Oct. 30, 1833.

TO THE EDITOR.

Sir,—As the American consul, Mr. Perrine, at Campeche, had recommended the introduction into Florida, of the Agave Americana, and other vegetables from which cordage, twine and thread, are made in that country and other countries, I thought it would be agreeable to him to see my paper on that subject, which was inserted in the 21st vol. of your Journal, and therefore sent it to him. He has acknowledged the receipt of it in a letter dated Sept. 2d, which I send you, as it contains very useful remarks.

As the project of Mr. Perrine is highly patriotic, and may essentially benefit Florida in the first instance, and the United States at large, I hope that Congress will liberally encourage him by the donation of as much land as he may require. The cultivation of the mulberry tree for silk, might go on at the same time with the fibrous plants. James Mease.

Consulate U. S. A. Campeche, 2d Sept. 1833.

Dear Sir,—I have the pleasure to acknowledge, in a pamphlet form, your article "on some of the vegetable materials, from which cordage, twine, and thread are made," which I first read in the American Journal of Science and Arts, the Oct. No. 1831. I adverted to the service you had thus rendered to the public, in a letter inserted the ensuing January, in some of our newspapers, and intended to correct some mistakes in your paper under the division of Agave Americana. Baron Humboldt is responsible for at least the following errors which have been propagated under this vague specific title, viz. that the singular drink called *Pulque*, the coarse fibres called *Henequin*, (Hane a kane,) and the fine fibres called *Pita*, are produced by one and the same plant. Having told us in his Essay on New Spain, that there are in the Spanish Colonies, several species of *Maguey*, which appear to belong even to different genera, the distinctive epithet *Maguey de Pulque*, should alone have led him to examine whether the same plant which is cultivated expressly for the juice of its stem, could possess coarse leaves of such extraordinary properties as to yield the fine fibres called *Pita*, of double their length. Nevertheless, up to the year 1822, in Kunth's synopsis of equinoctial plants, we still find Humboldt giving the *Agave Americana* as the only species of Spanish America, including equally the Maguey de Pulque of Mexico, and the Maguey de Coaeyza of Cumana. The facts are, 1, That there are varieties of another or other species of Agave, which are cultivated especially for the peculiar drink called Pulque, afforded by their stems.

2. That there are varieties of another, or other species of Agave, which are cultivated especially for their coarse fibres called Henequin, afforded by their leaves.

3. That there are varieties of other Bromeliaceous plants, which are not species of Agave, and which are not cultivated for the fine fibres called Pita, yielded by their leaves. The long narrow thin dry leaves which yield the scanty Pita, grow wild in the shade of the fertile forests of Tobasco: the broad, thick, succulent leaves which produce abundant Henequin, are cultivated in the sun, in the sterile plains of Yucatan.

The still larger and more succulent leaves of the true Pulque plants of Mexico, now growing in this city, are so destitute of either coarse or fine strong fibres, as to be easily broken or torn. Possibly the only genuine drink-producing Agave in the United States, is an almost mature plant which I sent to New Orleans, on the 22d of May last, after passing in a garden here, six years from the time of its youthful descent, from its native mountains. At all events, whether they be the Pulque or the Henequin plants, which, according to Persoon, under the name of *Agave Americana* have traveled as far as Switzerland to "form strong and impenetrable hedges which made great resistance to armies," we are warranted in the belief, that they will flourish in the United States as far north as our own *Agave Virginica*, and that for the mere purpose of making live fences, they merit immediate introduction to extensive cultivation in the southern division of our confederation. The fibrous leaved plants are better adapted to cultivation in our southern latitudes, than the fibrous barked plants, but were the climate equally suitable, the former class are greatly preferable to the latter. Our own *Yucca filamentosa*, which produces the silk grass, as beautiful and strong, but not near so long as the Pita, may be immediately cultivated on an extensive scale: three years hence, the Sisal Agave may begin to yield its perpetual crops of Henequin or grass hemp, on our sandy shores; in a few years more we may have hedges of the fibrous species of

Bromelia, of Pandanus, of Aloes, &c. &c., whose clippings will test the relative value of their leaves for thread, twine and cordage. The Ticu Palm mentioned as a substitute for flax and hemp by the Rev. Mr. Walsh in his notice of Brazil, in 1822, and the Sago Palm of Rumphius cited by you, on account of the superior fibres of its leaves, will certainly grow with the Cocoanut Palm which exists at Cape Florida; and if the leaves of the *Musa textilis* should indeed yield the manilla hemp,* as mentioned by you on the authority of Mr. Crawford, we can insure its flourishing with its brothers, the M. *paradisiaca* and M. *sapientum* in the tropical half of E. Florida.

The southern states have already their native Yuccas, which may be augmented by the Y. acaulis or Magauy de Cocuy of Caraccas, or any other foreign species which may be superior to our own. As preferable substitutes for hemp, we may translate from Yucatan to Florida, the cultivated Sacqui and Yashqui of Sisal, or the prickly or prickless leaved Agaves which yield very different qualities of Henequin, which may soon be increased by the Haytien species cited by yourself, and by every other species or variety possessing peculiar properties to be found in any part of the West Indies or Spanish America.

The Yucca filamentosa, the Agave Sisala, and the fibrous leaved plants in general, are superior to flax and hemp plants, in being perennial, flourishing in the worst soils and situations, requiring little care or cultivation, and furnishing leaves for cutting every day in the year. The preparation for market, or the extraction of the parallel longitudinal fibres of the fresh leaves by *scraping only*, is the most simple operation possible for either the hand or machinery,† and hence the article when prepared for market, must be much cheaper than that from flax or hemp, and as they are also lighter, and more elastic, their relative and positive prices will give to the former a preference for all the purposes in offering a competition between them.

The wild plants called Ixtla which abound in the country watered by the rivers Tobasco and Goazacoalcos, and from which the Pita of Mexico, is obtained, would readily be mistaken in the first stages of their growth for the cultivated pine-apple plants, but at no period

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* I am induced to believe that these fibres are obtained from some other Bromeliaceous plants.

† My invention can be expressed in two words;—Rotary Scraper.

could they be reasonably compared to the Agave, or Aloes. According to Don Ramon de la Sagra, in his recent work on Cuba, the Pita of that island is obtained from the *Tureroea fœtida* of the botanists, but as he has requested me to send to the botanic garden of Havanna, some plants of the Pita of Goazacoalcos, which are much exported from Campeche, he must suppose that the latter is produced by a different species, if not a different genus. Although I arrived in my consular district in June, 1827, and have traveled three hundred miles S. W. into the Pita country, I have never been able to see a single specimen of the plant in flower. The Pita of Goazacoalcos, is preferred to that of Tobasco, in the market of Yucatan, and is the imported material of which in Merida, "the most beautiful sewing thread," mentioned by you to have been brought to Philadelphia, by Capt. Hays, was made, and not from the fibres of the Henequin.

As there are two species of fibrous plants employed in Guatemala, for making ropes, the one cultivated expressly for its leaves, the other called Pinuela, being used also for hedges, it is doubtful whether Dunn has correctly quoted the name Pita, as a synonym for Henequin in that country. The Bromelia Penguin which is used for fences in Jamaica, on account of its prickly leaves, is also valuable for the strong fibres afforded by them, and ropes are said to be made in Brazil, of another species called Grawathos. Depons says, (Vol. III. p. 133,) that at Carora, in Columbia, they make very good hammocks of the fibres of the Aloe disthica. Of the leaves of the Guinea Aloes mentioned by Adanson, the negroes make very good ropes, not apt to rot in water; and Sloane says, "that one sort is used for fishing lines, bowstrings, stockings and hammocks."

As the contents of each leaf are generally tied together, the slender knot of the long flax-like Pita, cannot be mistaken on comparison for the stout knot of the short hemp-like Henequin. The different qualities of Henequin are obtained in this peninsula, from different species of Agave, of which two are chiefly preferred for cultivation. The Sacqui is the favorite in the vicinity of Merida, but the new plantations forming near Campeche, are filled with Yashqui.* These native names signify the white-leaved and the green-leaved Henequin. The leaves of the first are edged with stout prickles, those of the latter have scarcely any prickles, and sometimes none

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* Sack-kée and Yask-kée. The fibres of all are here called Sosquil, (Sose-keel.)

at all. The Chululqui is thought to be nearly equal to the Saqui; and the Chelém to bear some resemblance to the Yashqui. The duration of the Sacqui, is limited at 10 or 15 years, and the biennial reproduction of plants from its roots, at eight or ten young plants; while the duration and reproduction of the Yashqui is only rated half as high. Here the people begin to be sensible of the value of their Henequin: and the first agricultural association ever formed in Yucatan, is a company for its cultivation. I impressed them with the opinion, that by it they would extract more wealth from the sandy and rocky surface of this peninsula, than from all the gold and silver mines of Mexico.

I am, very respectfully,

HENRY PERRINE.

ART. IX.—*Descriptions of some new North American Trilobites;* by JACOB GREEN, M. D., Prof. of Chemistry in Jeff. Med. College.

CALYMENE? ODONTOCEPHALA.—*Green.*

The outline of the buckler in this very remarkable species, is subtriangular. The *front* is separated from the *cheeks* by a deep groove on each side, its anterior edge is ornamented on each side by a kind of *Etruscan* border, composed of alternate projections from the outer edge of the shell inwards, and from the inner portions of the shell outwards; the square protrusions on the one side, occupying intermediate square spaces on the other. This singular and beautiful structure does not surround the anterior edge of the cheeks, but terminates at the separating furrow on each side. At the first glance, these projections in front, give to the trilobite the appearance of teeth. The surface of the *front* or middle portion of the buckler, is marked on each side near the oculiferous tubercles, with two deep pits producing several irregular pleats or folds, somewhat like those on the front of Calymene Blumenbachii of Brongniart. The *cheeks* are triangular in shape: their lateral edges are terminated by a plain raised hem, which corresponds in breadth with the ornamented border of the *front*. The oculiferous tubercles are very prominent, are almost encircled at their base by a deep groove, and have at their apices a semilunar depression. A shallow depression also passes from behind each of the eyes, over the surface of the cheeks, nearly parallel with the furrow which separates them from the front.

The buckler is the only part of this very singular trilobite, which has yet been discovered. I have therefore more hesitation in deciding whether it be a Calymene or not. It has been suggested, that the extremity of the tail is furnished with an organization similar to the ornament on the edge of the front, and that a portion of the ornamented edge in that part is produced by the position of the animal; it being coiled or rolled up so as to bring the edges of the buckler and tail together. If this should turn out to be the fact, this trilobite cannot be a Calymene.

I am indebted to the liberality of Dr. J. E. Dekay, of New York, for this very curious species. It occurs in a soft grey sandstone, and was found in the State of New York, but its precise locality I was unable to ascertain. It was probably obtained in Ulster County, among the fragments of sandstone, rolled from the Shawangunk mountains, and which are so rich in fossil remains.

Asaphus Astragalotes.—*Green.*

We have met with a perfect fragment of the *abdomen* and *tail* only, of this striking Asaph. It comprises four distinct costal arches of the lateral lobes; these are terminated by a narrow well defined membranaceous expansion along their outer edges. The *ribs* are broad and faintly grooved on their upper surface; the *middle lobe* is rounded—exceedingly prominent, and terminated rather abruptly near the central part of the membranaceous expansion, which appears to be supported by a thin short prolongation from it, as in the *A. micrurus.* The upper surface of the whole animal, appears to have been covered with minute granulations.

The fossil from which our description is made, I observed in the fine cabinet belonging to the Lyceum of Natural History in the city of New York. There is a number of specimens of this species, in that important, extensive and liberal institution; but they are all fragments, presenting the same general appearance as the one above described. They were obtained from Greenville canal, in Upper Canada, and are imbedded in a soft dark colored argillaceous shale, associated with other animal remains, some of which are exceedingly minute.

Asaphus tetragonocephalus.—*Green.*

The *buckler* of this Asaph, which is still found attached to the abdomen, resembles in its contour a long crescent; the anterior edge in front is almost rectilinear; the posterior angles or horns of the crescent, are very acute, and project a little on each side, beyond the abdomen. The *front* or middle lobe of the buckler, is nearly straight before, and is marked with two short oblique grooves on each side; the anterior groove has a little pit, or depression of the shell, immediately before it on each side. The *cheeks* are remarkably large in proportion to the front, and there is a raised line passing over them from the front, nearly parallel with its edge, and also with that of the buckler; this organization gives to the head a quadrilateral appearance; much more obvious in some specimens than in others. The oculiferous tubercles can scarcely be discerned; in some of the fragments of the buckler which I have examined, I could not discover them at all. The *abdomen* is composed of twelve articulations; the costal arches or ribs are marked on their upper surface with a groove, and they terminate in free angular extremities. The middle lobe of the back is scarcely tapering, till within a few articulations of the extremity of the tail. The tail is quite short, rounded, and without the membranaceous expansion so common in the Asaphs; indeed this species forms an inosculating link between the genus Calymene and Asaphus.

I am indebted to the kindness of Dr. J. E. Dekay for this species. It occurs in a loose, bituminous shaly limestone full of iron pyrites. It was found in the State of New York, probably at Newport. The whole animal is very much depressed; and the rock is completely filled with its mutilated remains, some of which are still covered with the original crustaceous shell.

Paradoxides Harlani.—*Green.*

The contour of the buckler in this species, cannot be satisfactorily determined from our present specimen; the anterior and posterior parts of it are well defined, but the cheeks on each side are either mutilated or obscured. The *front* is very much elevated above the surface of the cheeks. It rises a little before the anterior edge of the buckler; is rounded in front, and gradually tapers towards the middle lobe of the abdomen, with which it forms a regular continuation. On its posterior surface there are three transverse furrows; the upper one crosses it a little obliquely, and there is on each side above, a considerable protuberance. The *cheeks* were no doubt in the form of spherical triangles, but whether the outer angles terminated in acute prolongations, cannot from our specimen be determined. The *organs of vision* appear to be entirely wanting. There are two shallow depressions on each side of the cheeks, commencing near the protuberances on the front, and running towards the lateral edges of the buckler. The posterior border of the buckler where it joins the lobes of the abdomen, is marked by a transverse groove, nearly continuous with the lower transverse furrow on the front; this groove at its commencement, appears to bifurcate outwards.

The *abdomen* and *tail* cannot be distinguished from each other. There are seventeen distinct articulations in both. The middle lobe is very convex, and is separated from the lateral ones, by a deep channel; it gradually tapers to an obtuse tip. In our specimen there is a small part of the tail of another trilobite deposited in this place, which at first sight appears to be a dislocated fragment of our animal.

The *lateral lobes* are flattened; the costal arches are very distinct near their insertion, and for about half their length, but towards their free extremities they are a good deal obliterated. There appears to have been a delicate *membranaceous prolongation* for a considerable distance beyond the solid portion of each rib. This organization is very apparent on the costal arches of the tail. There is a deep groove running obliquely over the upper surface of each rib. *Length* of the fossil about nine inches; *breadth* about four inches.

This remarkable species of trilobite I have named in compliment to our zealous naturalist, Richard Harlan, M. D., who sent me the specimen above described, with the following note.

Dear Sir,—During my recent visit to Boston, I observed the fine specimen of trilobite which accompanies this note, in the cabinet of Mr. Francis Alger, to whose politeness I owe this opportunity of offering you an additional species for your interesting and useful monograph of American trilobites. The present specimen is undoubtedly American, though Mr. Alger expressed some doubt as to its precise locality. He supposed it to be from Trenton Falls, in the State of New York. I have the honor to be respectfully,

Your friend, &c.

Philadelphia, March 27th, 1833. RICHARD HARLAN.

As the *P. Harlani* is in flinty siliceous slate, it does not probably occur at Trenton Falls, where the rocks are mostly formed of carbonate of lime. Our species resembles very much the *P. Tessini* of Brongniart, a representation of which he gives from Prof. Wahlenberg, on Plate 4, fig. 1, which fossil is the old *Entomolithus paradoxus* of Linnè, and has been found only in Westrogothia, at very great depths, " dans les couches d'ampelite alumineux."

ART. IX.—*Description of some New Species of Fresh Water Shells from Alabama, Tennessee, &c.;* by TIMOTHY A. CONRAD, Member of the Academy of Natural Sciences of Philadelphia.

UNIO CŒLATUS. Pl. 1. fig. 2.

Shell sub-triangular; much compressed, surface waved and with small irregular undulations becoming profound towards the posterior margin; anterior side and umbo destitute of undulations; umbones flattened; beaks prominent.

Inhabits Tennessee, Elk and Flint rivers, and is rare. Length 1.8 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell sub-triangular; very inequilateral, and much compressed, with a broad furrow extending from the beaks to the base; anterior sides and umbo entire, and the remaining parts furnished with small irregular interrupted undulations, which are profound behind the umbonial slope; surface rough, with distant slight concentric grooves; umbones much flattened; beaks prominent, compressed; epidermis dark olive, and obscurely rayed; cardinal and lateral teeth very robust; anterior and posterior muscular impressions profound; nacre pearly white and iridescent.

Observations. This is a remarkable and very distinct species; very similar in outline to the *U. securis* of Lea; but differing from all its congeners in the singular manner in which its undulations or incipient tubercles are disposed; it is nearly as much compressed as the *U. securis.* The epidermis in some specimens is almost black.

UNIO PEROVATUS. Pl. 1. fig. 3.

Shell ovate, ventricose, valves moderately thick; beaks rather prominent, cardinal teeth erect; lateral teeth rectilinear, compressed; nacre white.

Inhabits Prairie creek, Marengo Co. Al. rare; Length 1.9 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell ovate, rather ventricose, valves thick on the anterior side, but becoming much thinner on the posterior; anterior margin regularly rounded; basal margin rounded; posterior extremity subangulated; beaks a little elevated, approximate and undulated at tip; epidermis olive, and wrinkled towards the margin; cardinal teeth erect and prominent, not very thick; lateral teeth rectilinear, compressed; anterior muscular impression profound: posterior one slightly impressed; nacre white.

Observations. The regular ovate form of this shell will distinguish it from most other species. The young shell, however is broader behind, approaching to an oval figure, and is prettily ornamented with green rays on an olive yellow ground.

Unio lienosus. Pl. 1. fig. 4.

Shell narrow-elliptical, ventricose; beaks approximate, little elevated and corrugated; posterior basal margin abruptly rounded; posterior end sub-angulated; cardinal teeth rather compressed and oblique, and double in both valves.

Inhabits small streams in South Alabama. Length 2.8 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell narrow-elliptical, ventricose or inflated in old shells; subtance of the valves thick before and thinner behind; posterior dorsal and basal margin rounded, and the end subangulated; beaks approximate, not very prominent, and with interrupted undulations; concentric lines coarse and prominent; epidermis very dark olive, and obscurely rayed; wrinkled on the margin; cardinal teeth double in both valves, a little compressed and oblique, and coarsely striated; cavity most capacious under the umbonial slope; nacre varying from bluish white to deep salmon color, or purple.

Observations. This species is remarkable for preferring the smaller streams to the rivers, and is not an uncommon shell in such waters, I found them in company with the *U. rubiginosus*, Lea, which though not very rare in the small creeks of South Alabama, I never found in either the Black Warrior or Alabama rivers.

Unio stramineus. Pl. 1. fig. 6.

Shell sub-oval, posterior side wider than the anterior and rounded; beaks slightly prominent, with irregular undulations; umbones convex; concentric lines remarkably coarse and prominent; cardinal teeth double in both valves, and sub-compressed: nacre pearly white and iridescent.

Inhabits with the preceding species. Length 2.5 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell sub-oval, convex, inflated behind the middle; posterior side wide and rounded at the end; posterior dorsal and basal margins abruptly rounded; umbonial slope disposed to be subangulated; surface with strong prominent concentric lines and undulations; beaks slightly prominent and with undulations disposed in angular lines; epidermis straw colored, rayed only behind the umbonial slope; wrinkled only at the two ends; cavity most capacious behind the middle of the valve; nacre pearly white and iridescent.

Observations. Approaches the *U. abruptus* of Say, and is a very rare species; a specimen very much resembles the *U. cariosus* of the Delaware and Schuylkill rivers.

Unio arcus. Pl. 1. fig. 8.

Shell narrow-elliptical, thick and ponderous; dorsal margin regularly curved, or arched; beaks scarcely above the dorsal line; basal margin straight, posterior side somewhat cuneate.

Inhabits Alabama river. Length 2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell narrow-elliptical, thick and ponderous; dorsal margin forming an arched curve, which is scarcely interrupted by the beaks, umbonial slope abruptly rounded posteriorly, basal margin straight; epidermis olive and wrinkled; cardinal teeth thick, pyramidal; distant from the lateral teeth; anterior muscular impression profound; posterior rather deeply impressed; cavity not capacious; nacre pearly white.

Observations. This is a rare shell, and distantly related to the *U. phaseolus* of Hildreth; it is not however so compressed, is more pointed behind, &c. and differs altogether in the epidermal markings or color. It is never rayed.

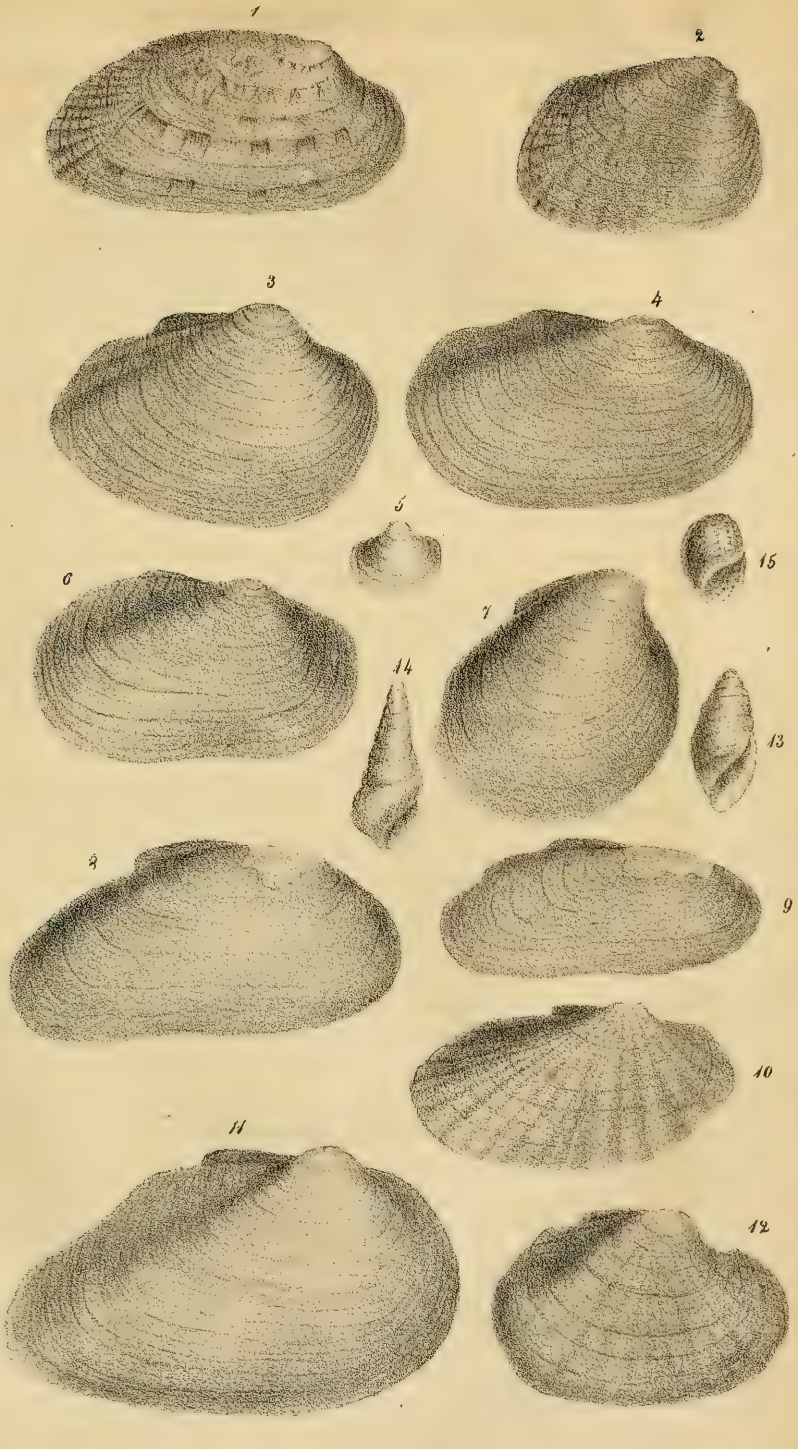
Unio arctatus. Pl. 1. fig. 9.

Shell narrow-elliptical, elongated, much compressed; and slightly contracted over the umbo to the base; beaks not prominent; basal margin slightly arcuated, cardinal and lateral teeth distinct.

Inhabits Black Warrior and Alabama rivers. Length 2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell elongated, much compressed, slightly contracted from the beaks to the base; posterior side much produced and sub-angulated at the end; beaks depressed; epidermis very dark olive; cardinal teeth disposed to be single in both valves; lateral teeth compressed and a little prominent, nacre bluish white.

Observations. This shell has somewhat the form of the *U. monodonta*, Say, but it is more nearly allied to *U. purpureus* of Say



T. A. Conrad del.
On Stone by A. Rider.

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than to any other species. Beside its other characters, the uniform bluish white color of the interior will distinguish it from the latter.

ALASMODONTA RADIATA. Pl. 1. fig. 10.

Shell ovate-acute, ventricose; posterior end produced and pointed at the end; cardinal tooth in the right valve elongated and anterior to, and distant from the beak; cardinal tooth in the left valve elongated, and situated immediately under the beak.

Inhabits small streams in South Alabama. Length $2\frac{1}{2}$ inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell ovate-acute, ventricose, with the posterior side produced and pointed at the end; beaks prominent and pointed at the apex, which has two or three profound undulations; epidermis light olive, beautifully rayed with dark green; cavity capacious; nacre waxen yellowish.

ANODONTA SUBVEXA. Pl. 1. fig. 12.

Shell sub-oval, inflated; thin; anterior end rounded; posterior end subtruncated; posterior dorsal margin elevated and abruptly rounded at the extremity; callus resembling an incipient tooth.

Inhabits Black Warrior river. Length about 2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia. Very rare.

Shell sub-oval, inflated, thin, with prominent beaks, undulated at the apex, and not distant from the middle of the valve; umbo inflated; umbonial slope angulated, and the space behind with radiating lines; epidermis olive and rather obscurely rayed; cavity very capacious, most so behind the middle; nacre bluish, stained with a light waxen yellow.

ANODONTA DECLIVIS. Pl. 1. fig. 11.

Shell sub-ovate, thin, slightly ventricose; posterior end produced and cuneiform; margin of the dorsal slope nearly rectilinear, and the extremity truncated; beaks slightly prominent and tuberculated at the apex.

Inhabits Flint river, Morgan Co. Alabama, extremely rare. Length $3\frac{1}{2}$ inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell sub-ovate, thin, slightly ventricose; umbonial slope angulated; posterior dorsal margin rectilinear; epidermis green olive, with dark concentric wrinkled lines; and on the posterior slope are numerous interrupted irregular lines; space behind the umbonial slope flattened;

nacre waxen yellow, except on the margin, which is pearly white and highly iridescent.

CYCLAS STAMINEA. Pl. 1. fig. 5.

Shell oval, ventricose, inequilateral; with numerous regular prominent concentric lines; beaks slightly prominent; anterior and posterior ends nearly equally rounded; cardinal teeth none; lateral teeth distinct.

Inhabits small streams in South Alabama. Figure of the natural size. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell oval, regularly convex; inequilateral; anterior and posterior ends similarly rounded; umbo inflated; beaks a little prominent, apex obtusely rounded; epidermis yellowish, with darker stains; lateral teeth rather prominent; nacre bluish white; cavity capacious.

MELANIA OLIVULA. Pl. 1. Fig. 13.

Shell oblong or narrow-elliptical, smooth and entire; spine conical; volutions five; suture impressed; aperture somewhat elliptical, longitudinal; about half the length of the shell, color green olive; with strongly marked brown revolving bands; about 4 on the body whorl.

Var. A. Much more elevated, with a truncated or eroded apex; the whorl flattened, and the spine less conical.

Observations. Inhabits the Alabama river, adhering to the soft calcareous banks, which it perforates in such a manner that they resemble honey comb, or wood pierced by *Teredo navalis.*

MELANIA PRASINATA. Pl. 1. Fig. 14.

Shell subulate, slightly turrited; whorls 7 or 8, flattened; aperture elliptical, a little oblique; about one third of the length of the shell; body whorl sub-angulated at base; epidermis green olive.

Var. A. with broad revolving costæ, those on the body whorl crenulated.

Inhabits Alabama river, adhering to limestone rocks. Cabinet of the Academy of Natural Sciences of Philadelphia.

ANCULOSA PICTA. Fig. 15.

Shell sub-oval, shoulder obtusely rounded; aperture obovate, large; columella callous above; epidermis olive, with numerous quadrangular small spots disposed in revolving lines, strongly marked in the aperture.

Inhabits Alabama river, adhering to pebbles on the bars. Cabinet of the Academy of Natural Sciences of Philadelphia.

UNIO SUBTENTUS. *Say.* var. Pl. 1. fig. 3.

This beautiful variety of the *U. subtentus* was found by me in the Tennessee and Elk rivers. The annexed delineation of the species is probably better than any hitherto given.

UNIO MYTILLOIDES. *Raf.* var. Pl. 1, fig. 7.

I obtained this shell in the Alabama river. Its characters appear to be intermediate between *U. ellipsis*, Lea, and *U. mytilloides*, Raf., yet is doubtless identical with the latter species.

SUPPLEMENT.

PLANORBIS ANTROSUS.

Shell dextral, not depressed; whorls three; spire profoundly indented, or concave, with the summit of the body whorl angular; inner volutions angulated; umbilicus profound, with the margin and inner volutions angulated: body whorl abruptly dilated near the aperture; aperture longitudinally subovate, dilated.

MELANIA CONGESTA.

Shell subulate, with about nine volutions, the lower ones obscurely angulated, those of the spire becoming acutely carinated towards the apex; suture well defined; body whorl obscurely sub-angulated; aperture longitudinal, elliptical.

PHYSA POMILIA.

Shell with four volutions, horn colored and polished; spire short conical; body whorl ventricose; aperture patulous.—REMARK. It resembles *P. heterostropha*, Say, but is much smaller and thinner.

These three univalves inhabit Randon's creek, near Claiborne, Alabama, adhering to Limestone rocks.

(To be continued.)

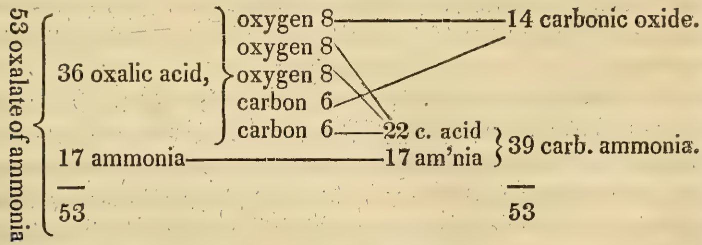
Art. X.—*Carbonic oxide gas, obtained free of carbonic acid;* by Thomas D. Mitchell, M. D. Professor of Chemistry and Pharmacy in the Medical College of Ohio.

It will be readily conceded, that a process, by which a difficulty can be avoided entirely, will be more acceptable to the practical chemist, than one, however ingenious, that instructs him how to get rid of that difficulty, after it has occurred. Several foreign writers have recently proposed methods, for ridding carbonic oxide of carbonic acid; and in a late number of the American Journal, conducted by Professor Silliman, I find a communication from Professor Hare, on this point. He has furnished a drawing of his apparatus, intended to accomplish the object in view, with such explanations, as he supposed necessary. It is obvious however, that if such an expedient were at all requisite, many persons would fail in its construction, by the aid of the description and drawing alone; for although it may be perfectly plain to the inventor, it will not follow, that others may easily imitate him.

The plan which I adopted is very simple and perfectly successful. I was led to its use, not because I supposed the formation of carbonic acid would be obviated, but because I had found considerable difficulty by other processes. It was my design to have employed the super or bin-oxalate of potash, as recommended by Dumas, and in that case, it would have been necessary to have washed the product with lime water. Fortunately, however, my bottle containing that article was mislaid, and, in its place, I substituted the oxalate of Ammonia, uncertain what would be the precise result. My first notice of this experiment, is contained in the *Western Medical Gazette* for January 15th of the present year, but as I have had opportunities since that date of confirming the views then entertained, I think it may not be unacceptable to chemical teachers, to give the subject a brief notice, through the medium of a journal that has a wider circulation.

I repeat then, that I have obtained the carbonic oxide, of an excellent quality, independently of the use of lime water, or any other agent, for the purpose of detaching carbonic acid, by the action of sulphuric acid on the oxalate of ammonia. Take an ounce of the oxalate, reduced to powder, and a drachm or two of sulphuric acid, and put them into a six-ounce tubulated retort, and apply a very gentle lamp heat. In a few minutes, large quantities of gas are evolved, and may be collected in the usual manner over water. If the heat be duly moderated, the first and last products, as obtained in the receivers, will be pure carbonic oxide gas. The sulphuric acid seems to act, by resolving the oxalate into oxalic acid and ammonia; then to decompose the oxalic acid into its elements, and to put the whole into such a state, as to enable the constituents to recombine, so as to form the pure gas. That carbonic acid is actually evolved, cannot be doubted, but it seems to join the ammonia instantly, forming the carbonate of Ammonia, which is absorbed by the water, as fast as it is produced. If it is inquired, how it happens that the sulphuric acid does not instantly seize the ammonia and form a sulphate, I have only to say, that although the moderate heat employed, is amply sufficient to drive over the gaseous elements of the oxalate, it is inadequate to cause the sulphuric acid to do so.

The above statement will be better understood, by the use of a diagram; premising, that the equivalents or combining numbers of the several articles, are as as follow; *oxalic acid* 36, made up of 24, or 3 equivalents of oxygen, and 12, or 2 equivalents of carbon; *ammonia* 17, making the salt 53; *carbonic acid* 22, made up of 16, or 2 equivalents of oxygen, and 6, or 1 equivalent of carbon; *carbonic oxide* 14, composed of 8, or 1 equivalent of oxygen, and 6, or 1 equivalent of carbon.



If a very gentle heat be continued for some time, the same products will be had, independently of the use of sulphuric acid; but the latter seems to accelerate the process.

When we employ oxalic acid to make the carbonic oxide gas, a portion of carbonic acid is unavoidably formed, and must be removed by means of lime water. In like manner, this acid gas is generated or evolved, when the oxalate of ammonia is used, but as it combines instantly with the ammonia, it does not contaminate the desired product. A small portion of the carbonate of ammonia will be found along the beak of the retort, but for the most part, it is taken up by the water. The addition of a few drops of a solution of sulphate of copper to the fluid, strikes a blue color instantly, thus denoting the presence of ammonia. On examining the residuary matter in the retort, it is found to be strong sulphuric acid. I know of no other rationale of this process, and think it quite satisfactory. Of one thing, however, I am certain, and that is, that no other method that I have employed, yields the gas in question, so pure, and with so little trouble. It is, therefore, confidently recommended to all operators in chemistry.

Cincinnati, October 22, 1833.

Art. XI.—*A Sketch of the Mineralogy of a portion of Jefferson and St. Lawrence Counties, (N. Y.)*; by Drs. J. B. Crawe, of Watertown, and A. Gray, of Utica, (N. Y.)

The northern part of the state of New York, has for a long time been known to contain many interesting minerals. But with the exception of that portion which borders on Lake Champlain, this region has not received that notice from our mineralogists which its importance seems to deserve. In the spring of the present year, we visited this region for the purpose of collecting minerals, and had the good fortune to discover some interesting localities, a brief notice of which may not be unacceptable to the readers of the American Journal of Science.

The underlying rock at Watertown, Sackett's harbor, and throughout nearly the whole of Jefferson Co. is the metalliferous limestone of Eaton. This rock contains few minerals, but abounds in interesting organic remains. *Orthoceratites*, two to three feet in length are extremely common near Watertown and Brownville. *Ammonites*, *Madreporites*, Turbonites, &c. occur in great abundance. Two Trilobites, the *Calymene Blumenbachii* and the *Isotelus gigas* of Dekay, have been found near Watertown, but they are by no means common. In general this rock in Jefferson Co. contains the same petrifactions as at Trenton Falls on the West Canada Creek.

The *Lenticular Carbonate* of *Lime* is found in this rock at *Brownville*, four miles from Watertown. A single specimen of *Sulphate* of *Strontian* in slender crystals, was found on the same locality. On the shore of Lake Ontario, a few miles N. E. of Sackett's harbor, at a place called Pillar Point, is a locality of *Sulphate* of *Barytes*.

It occurs in a large vein in the metalliferous lime rock, extended directly back from the shore of the Lake, which has been exposed at various points, for about thirty rods. The mineral may be taken out in blocks, two to three feet in length, and a foot or more in width.

It is compactly fibrous, and banded, but never crystallized. The colors vary from pearl-white to flesh-red, and are arranged most commonly in stripes or rings. It takes a high polish; the polished specimens in thin slabs are translucent, and in some specimens semi-transparent. This mineral might be advantageously used for ornamental purposes. It may be obtained at the locality in any desirable quantity; it may be sawed and polished with great ease, and the polished specimens are very beautiful.

Some years ago, a cave of considerable extent was discovered near the village of Watertown. This cave furnished *stalactites* in great abundance, but all the interesting specimens have long since been carried away by mineralogists and other persons who have visited it. Very fine specimens of *Agaric mineral*, in large masses, may yet be obtained at this locality.

From Watertown proceeding in a North easterly direction eight or ten miles, we see the lime rock cropping out, and we come upon the Calciferous Sand Rock which passes under the Lime Rock and extends north and East until it meets with the primitive formation. The Calciferous Sand Rock, so far as we know, does not furnish any interesting minerals.

At *Theresa* on the Indian river, eighteen miles from Watertown we found *Crystallized Milk Quartz.* It occurs in a large vein in Gneiss. It is perfectly white, and contains crystals more or less perfect running through it in all directions. The Crystals which are six sided prisms, entirely opaque, varying from two to seven inches in length, and from one half to two inches in diameter, sometimes are terminated by six sided pyramids at one or both extremities. Good specimens may still be obtained by blasting the rock. At Theresa we also find *Steatite* in considerable quantities, imbedded in granular lime rock. *Brucite?* is found in grains disseminated through the same rock.

In the town of Antwerp, Jefferson Co., twenty four miles from Watertown, we found, by the road side, a large boulder of granular lime rock, which contains *tremolite* in fine crystals; also crystals of *white augite.*

At Oxbow, on the Oswegatchie river, we find green crystals of Hornblende, variety *Pargasite.* The same mineral is found more abundantly in the town of *Rossie*, St. Lawrence Co. two or three miles from Oxbow, on the road to Rossie furnace. It is found by the road side, in granular lime rock, which, with the gneiss, crops out very conspicuously for some distance. It is crystallized in prisms from one to three inches in length, and from half an inch to one and half inches in diameter.

The town of Gouverneur, in St. Lawrence Co., furnishes many minerals of still greater interest. The rock here is Granite, associated with Granular lime rock. The lime rock, in many places, is sufficiently compact to be sawed into slabs, and take a good polish, and some quarries are worked with advantage, and afford a handsome marble; but generally it disintegrates rapidly whenever it is exposed to the air, breaking into rhomboidal fragments. One mile south from the village of Gouverneur, on the road to Watertown, the Granite and Lime rock crop out abundantly on both sides of the road.

The granite here consists almost entirely of Feldspar. It contains very little quartz, and not a particle of mica. On the west side of the road there is a deep fissure in the granite, five feet wide and thirty feet in length. On removing the soil and loose stones from this cavity, we found both sides completely studded with crystals of *feldspar* and green augite. The crystals of feldspar are flat prisms or tables variously modified, and of different sizes. Many of the crystals are weathered, and have lost their lustre, but the most perfect specimens are those which have been protected by a covering of calcareous spar. These have fine polished faces, frequently six or seven inches in width, of a greenish color, with considerable lustre. Good specimens can be obtained only by considerable expense of time and labor, it being necessary to blast the rock to the depth of six or eight feet. The Augite is found with the feldspar in crystals one to four inches in length, but destitute of lustre.

Directly opposite, and about twenty rods from the road, the granite and crystalline lime rock are elevated in irregular ridges.

At one locality, where the marks of considerable labor appear, we discovered *scapolite*, and phosphate of lime. A cavity eight feet deep and ten feet in length, has been made by blasting the rock just at the junction of the granite with the lime stone. The scapolite is found in groups of short crystals, disseminated through the limestone in great abundance. They are white, and generally translucent, with highly polished faces. The most common form is a four sided prism, with the edges replaced, and terminated by four sided pyramids at one or both extremities. The crystals vary from one eighth of an inch to two inches in diameter, but the large crystals are not abundant. We have the same mineral in small and less perfect crystals, in a similar gangue, from Grenville, Upper Canada. The specimens of phosphate of lime from this locality, are probably the most remarkable both for size and perfection of crystals, that have ever been found in the United States. They are found in the lime rock, but always within a foot or so of the granite, and are most abundant very near the junction of the two rocks. We obtained crystals nearly six inches in length, and an inch and a half in diameter. They are perfect six sided prisms, of a fine sea-green color, and variously modified at their terminations. The smaller crystals are nearly transparent, and equally perfect. By continuing the excavation, and removing the rock by blasting, which will be attended with considerable labor, there is little doubt the mineral may be obtained in any desirable quantity.

In another locality in the same field, we met with a few crystals of smaller size and less perfect in form. It is highly probable that other, and perhaps superior localities of these minerals, will be discovered whenever this region is more thoroughly explored. Nearly all the rocks that are scattered through the field, and by the road side, contain brown *tourmaline*, in crystals varying from one inch to several inches in length. Indeed crystals six inches in length, and from one to four inches in diameter, more or less perfect, are not uncommon. They vary in color from light reddish brown, color of cinnamon stone, to dark brown. This mineral is apparently inexhaustible, and may be obtained without blasting.

In the town of Dekalb, eight miles from Gouverneur, on the road to Ogdensburgh, we find *brown tourmaline* in very perfect crystals, imbedded in tremolite. It is difficult to obtain perfect crystals, on account of the tenacity of the tremolite which contains them, but although smaller they are more perfect in form, and have a higher lustre than the specimens from the locality in Gouverneur. Near the bridge across the Oswegatchie river, at the village of Gouverneur, we find *noble serpentine*, in masses, imbedded in limestone of a fine green color, capable of taking a fine polish.

One mile below the village of Gouverneur, on the bank of the river, we obtain *calcareous spar* in fine rhombs, translucent to transparent, exhibiting double refraction very perfectly. Good specimens can be obtained only when the water in the river is quite low.

In the town of Fowler, twelve miles from Gouverneur, is a bed of bog ore, which contains perfect impressions of the leaves and strobiles of the Hemlock, and both hemlock and birch roots, from one to two feet in length, and several inches in diameter, which, although they are completely converted into bog ore, retain their original appearance very perfectly. In the same town, ten miles south of the furnace at Fullerville, is a rich deposit of iron ore, known as the Wilson ore bed. Here we find the *red oxide* and the *granular micaceous oxide of iron.* This last contains numerous cavities or geodes, completely studded with thin very brilliant plates or crystals, resembling specimens of the same ore from Elba. The proprietor of the furnace at Fullerville, attempted to work this ore, but owing to some unknown cause, he did not succeed in reducing it. He states that when he was attempting its reduction, the furnace was filled with very offensive fumes, which, as he supposes, caused the sickness of several of his workmen, and in consequence, the ore, which is undoubtedly very rich, was abandoned.

No odor is perceptible when this mineral is struck with a hammer, or when submitted to the flame of a lamp, urged with a blow-pipe. From Duane, Franklin Co. we have *hypersthene* and octahedral iron ore, strongly magnetic ; a piece weighing about four ounces lifts a large nail. It is said to be abundant.

A singular iron ore has recently been discovered at this place by Mr. Duane, which is capable of being converted directly into steel, without undergoing previous cementation. Mr. Duane has erected extensive works for the conversion of this ore into steel, and the article is in market, and bears a good price. This ore is not the spathic iron or proper steel ore. It resembles the octahedral iron, but is only slightly attracted by the magnet. It is perhaps a form of the specular iron, but we were not aware that this ore was capable of being manufactured directly into steel.

Plumose Iron Pyrites in fine specimens, is found at Champion, in Jefferson Co.

Galena in rolled masses of considerable size, is found in alluvial earth and clay, near the shore of Lake Ontario, in the town of Henderson, Jefferson Co. Since our visit to these localities, we have received through Dr. Murdock, of Gouverneur, *copper-colored mica* in broad folia. Among our specimens we notice rhombic prisms (the primitive form) and six sided prisms several inches in diameter.

As soon as other engagements will permit, we intend to explore this region more thoroughly, as we have no doubt it will richly repay any mineralogist for the time he may devote to its examination.

Art. XII.—*Geology and Meteorology west of the Rocky Mountains.*

(Communicated by Prof. Amos Eaton, of the Rensselaer School.)

In exhibiting a transverse section across North America, at page 59 of 2d Ed. Geological Text Book, I was compelled to admit the word *unknown*, west of the Rocky Mountains. While I was preparing that work, John Ball, Esq., a graduate of Dartmouth College, Counsellor at Law, &c. was my pupil in Natural History. In less than twenty months from the time of his leaving this school, he furnished me with all that is necessary for filling up that blank in the profile.

I pledge myself for Mr Ball's accuracy, because *I know him.* He is most scrupulously exact in relating scientific truths, and a very accurate observer. I received his last letter, which he wrote to any part of this district, by the Fur Company, *via* Canada, dated March 3d, 1833, at Fort Vancouver, near the mouth of the Oregon, (Columbia river.)

The geology of the country west of the Rocky Mountains is remarkably simple and uniform. The general underlying rock is the Red sandstone, which some English geologists call saliferous rock, and which characterizes the red sandstone group of De La Beche. It is the same which contains the salt springs of the western part of the State of New York, and which underlies the basaltic rocks (greenstone trap) of Connecticut and Hudson rivers. It is the same which Dr. Edwin James describes, (See Long's Expedition) as the chief basis rock between the Rocky Mountains and the Mississippi. Therefore the geology of the east and west sides of the Rocky Mountains is remarkably alike. Mr. Ball says, "the Rocky Mountain rises up from the midst as it were of a horizontal sea of red sandstone; as if some tremendous force had driven it upwards, like an island forced up from the depths of the ocean."

Mr. B. agrees with Dr. James, in comparing the Rocky Mountains with Humboldt's description of the Andes; of which it is probably a continuation. It consists of slaty granite (gneiss) Hornblende rock, talcose slate, and some mica-slate. The talcose slate is probably a continuation of that which contains the gold of Mexico.

Mr. Ball considers almost the whole country as volcanic, if basaltic rocks resting on red sandstone are to be considered as volcanic. In numerous localities the red sandstone resembles the half-melted bricks which surround the flues in a kiln. The basalt (greenstone trap) has the appearance of scoriæ or smith's slag, at and near the base of basaltic columns. These columns are mostly regular polyhedra, often as perfectly pentahedral as those brought from the Giant's Causeway in Ireland.

The red sandstone often rises in peaks, like those on Connecticut River, between Northampton and Greenfield, several hundred feet in height; while channels of rivers open the rocks at their bases to a great depth. The grey puddingstone, which often caps the highest peaks, seems to defend it from the rapid disintegration to which the sandstone is subject. Many of these prominences are covered with eternal snow, never melting in the greatest heat of summer.

Near the west side of the Rocky Mountains, and along the upper branches of the Colorado, which falls into the Gulf of California, and the Lewis river, which unites with the Oregon, Mr. Ball found first graywacke and sparry lime rock. But he soon entered upon the red sandstone region; which continues, as the basis rock to the Pacific. After travelling about one hundred miles from the Rocky Mountains, the primitive boulders disappeared. The country is often very mountainous along the route to the Pacific; but the mountains are red sandstone, grey puddingstone, or basalt. Such is the simplicity and uniformity of the geology of the vast region west of the Rocky Mountains, that it can all be told in one sentence of six lines.

The most astonishing facts, communicated by Mr. Ball, relate to the Meteorology of that country. From the first of June 1832, to the first of November, (5 months) less than one inch of rain fell between the Rocky Mountains, and a strip of land from one hundred and fifty to two hundred miles in width bordering on the Pacific. Vegetation is exceedingly scanty thus far; and profuse beyond description as far as rains extend. For many hundred miles, the sky is always serene by night; and scarcely a cloud is seen by day. While crossing the barren plains, Mr. B. observed, that the flowers of plants greatly exceeded the herbage in size and brilliancy. All parts of the plants were much stinted in growth excepting the fructification. It seemed to him as if nature had manifested more solicitude for the reproduction of species there, than for their luxuriance.

The growth of all vegetables, along the two hundred mile border of the Pacific, is astonishingly profuse. The Deputy Governor of the English Fur Company, (Mc Laughlin) raised twelve hundred bushels of wheat, a great quantity of barley, peas, potatoes, &c., last summer, (1832). He had purchased in California a considerable number of cattle, sheep, goats, swine, &c., which he had increased to four or five hundred. He lent Mr. B. oxen, plough, cows, axes, &c., and he commenced ploughing in January, in Lat. 45° 37′.—The vegetables of the preceding season were still standing in gardens untouched by frost. New grass had sprung up sufficiently for excellent pasture. Fruit trees were in full blossom.

The society of gentlemen at this place (Fort Vancouver, Lat. 45° 37′, Lon. 122° 37′) is good, but they have natives for wives. They are selected from a very friendly tribe of Indians, who are averse to war and exceedingly peaceable. These wives soon learn English cookery, and perform other domestic duties in good style. Mr. Ball devotes part of his time to teaching the women and children. As the Indians near Rocky Mountain stole his clothes, excepting what he wore out, he arrived at Vancouver in Buffalo skins. The ladies immediately furnished him in the best style of the place.

The meteorological observations at the end of this article exhibit the remarkable uniformity of temperature through the winter months.

Though the latitude is nearly that of Montreal, mowing and curing hay are unnecessary; for cattle graze on fresh growing grass through the winter. Cordier's theory of internal heat, particularly that part of it, which supposes some portions of the earth better conductors of caloric than others, would seem to derive some plausible support from that temperature which seems neither to be influenced by the sun's rays, nor by elevation.

I have made these selections, instead of publishing Mr. B.'s letter, because he wrote in a familiar style, without any view to its publication.

From June 12th to October 1, while travelling West from the Rocky Mountain, across the Barrens, (says Mr. B.) we had scarcely any rain; and the heat ranged from 60° to 89°. In the fertile regions, the heat is generally much lower.

This meteorological table presents a subject for interesting enquiry. While the temperature was for some days from 12° to 15° below freezing, the most delicate fruit trees remained in full blossom, without being affected by frost. Is the earth absolutely warmed in a degree, uncommon in other countries, by internal heat? Is it to the same cause that we are to ascribe the rapid growth of vegetables, where the earth receives a due quantity of rain? Mr. Ball saw numerous warm springs issuing from beneath basaltic rocks along Lewis river, &c. The temperature of the water was generally about 100° Fah.

Troy, Sept. 6, 1833. AMOS EATON.

Meteorological Observations, made at Fort Vancouver, a few miles from the Pacific Ocean, north of the Oregon—Lat. 45° 37′, *Lon.* 122° 37′; *by* John Ball, Esq. A. M. (*late from Lansingburgh, N Y.*)

November.

Days.	M.	N.	Wind.	Weather.
1		52	W.	Clear.
2		52	N.W.	‘
3	32	55	‘	‘
4	‘	55	‘	‘
5	‘	‘	E.	‘
6	‘	‘	‘	‘
7	‘	‘	‘	‘
8	‘	‘	N.W.	‘
9	‘	‘	‘	‘
10	‘	‘	E.	‘
11	‘	‘	‘	‘
12	‘	‘	‘	‘
13	‘	‘	‘	‘
14	‘	‘	‘	‘
15	‘	‘	S.E.	Rain.
16	Not obtained.	58	N.W.	Clear.
17		50	E.	‘
18		45	S.E.	Rain.
19		45	‘	‘
20		50	‘	‘
21		50	‘	‘
22		46	N.W.	Cloudy.
23		50	‘	‘
24		50	S.W.	Showery
25		50	S.E.	Rain.
26		50	‘	‘
27	48	54	‘	‘
28	—	50	N.W.	Cloudy.
29	32	49	‘	Clear.
30	32	49	‘	‘
4½ inches rain.				

December.

Days.	M.	N.	Wind.	Weather.
1	40	40	S.E.	Rain.
2	42	40	‘	‘
3	50	48	‘	‘
4	47	40	‘	Pleasant.
5	48	41	‘	Rain.
6	47	40	‘	Pleasant.
7	40	32	‘	‘
8	40	32	N.W.	Cloudy.
9	44	38	S.E.	Pleasant.
10	43	37	‘	Rain.
11	42	38	‘	‘
12	42	38	‘	‘
13	46	38	S.	Showery
14	43	38	S.E.	Rain.
15	54	44	S.	‘
16	48	50	N.W.	‘
17	55	53	S.E.	‘
18	51	52	‘	‘
19	49	44	‘	‘
20	48	45	‘	‘
21	46	42	S.	Showery
22	41	40	‘	Rain.
23	43	40	‘	Showery
24	44	41	‘	‘
25	44	39	‘	‘
26	46	40	S.E.	Rain &
27	45	40	‘	Shine.
28	43	41	‘	Rain.
29	43	41	N.W.	Showery
30	42	36	‘	Pleasant.
31	44	32	‘	‘
9 inches rain.				

January.

Days.	M.	N.	Wind.	Weather.
1	40	32	N.W.	Cloudy.
2	40	35	‘	‘
3	45	38	‘	‘
4	42	38	‘	Clear.
5	43	32	E.	‘
6	39	32	‘	‘
7	38	32	‘	‘
8	35	28	‘	‘
9	34	25	‘	‘
10	32	32	‘	‘
11	40	32	‘	‘
12	37	25	‘	‘
13	33	18	‘	‘
14	32	17	‘	‘
15	33	17	‘	‘
16	33	20	‘	‘
17	28	20	‘	‘
18	39	26	S.E.	Hail.
19	40	34	‘	Rain.
20	55	44	S.	Rainy.
21	55	54	‘	‘
22	58	54	S.E.	Rain.
23	54	52	‘	‘
24	48	40	‘	‘
25	42	32	N.W.	Pleasant.
26	44	32	‘	‘
27	50	40	S.	‘
28	46	40	S.E.	Showery
29	44	39	varies	‘
30	45	39	‘	‘
31	47	40	‘	Pleasant ploughing.
1 inch rain.				

February.

Days.	M.	N.	Wind.	Weather.
1	47	40	varies	Showery
2	46	40	S.E.	‘
3	52	46	‘	Pleasant.
4	50	46	‘	Rainy.
5	51	45	‘	‘
6	51	47	‘	‘
7	47	43	N.W.	Pleasant.
8	47	43	‘	‘
9	44	40	N.E.	‘
10	45	32	‘	‘
11	45	32	S.W.	‘
12	46	38	‘	Showery
13	48	38	S.	Rain.
14	50	40	S.	Pleasant.
15	50	42	W.	Showery
16	45	33	S.	Cloudy.
17	50	40	‘	Rain.
18	50	41	S.E.	‘
19	51	43	S.	Showery
20	53	40	N.W.	Pleasant
21	50	42	‘	‘
22	45	37	‘	‘
23	44	32	‘	‘
24	44	32	‘	‘
25	45	32	‘	‘
26	50	32	W.	‘
27	55	32	E.	‘
28	55	32	S.E.	‘
3 inches rain.				
March.				
1	55	31	S.E.	Rain.
2	50	30	N.W.	Clear.
3	46	32	‘	‘

Art. XIII.—*On the Meteors of Nov.* 13, 1833; by Prof. Edward Hitchcock.

TO THE EDITOR.

Dear Sir,—Supposing that you will be desirous of obtaining for the next number of the American Journal of Science, details respecting the beautiful meteoric display witnessed all over the land on the morning of the 13th instant, I send you the following statement. I have delayed to do this for some days in the expectation that so many accounts would be sent you (or inserted in the public papers) from various parts of New England, that any thing from this place would be unnecessary. But I noticed a few facts in respect to this phenomenon, which I have not yet seen in any published accounts, and which seem to me to have an important bearing upon its explanation. I shall dwell chiefly upon these peculiar circumstances, since the general facts, as observed here, corresponded to those noticed in nearly every other place.

Many years ago I was exceedingly interested in Mr. Ellicott's account of a similar meteoric appearance which he saw near the edge of the Gulf Stream in 1799, which is inserted in the 6th Vol. of the Transactions of the American Philosophical Society. And the enquiry had frequently suggested itself to me, whether it might not have been an electro-magnetic phenomenon? His account and this enquiry were brought vividly to my recollection, only a few days previous to the 13th instant, by conversation with a friend: and when I saw the phenomenon so soon afterwards, my first thought was, can I discover in the direction in which those meteors move—as can be done in the corruscations of the *aurora borealis*,—any relation to the plane of the magnetic meridian? I directed my attention to such as I saw moving nearly north,—and they did not exactly coincide in direction with the meridian of the place, but, as nearly as I could judge by the eye, made an angle with it on the west side from 5° to 10°; thus agreeing almost exactly with the plane of the magnetic meridian; the variation of the magnetic needle being here, about 6° west. It was obvious that none of the meteors in the northern part of the heavens described curves coincident with vertical circles, and that these curves, if prolonged so as to cut the horizon, made the angle of intersection on the left hand upper side greater than 90°, and less on the right hand upper side. Such effects would result, if the meteors in their motion had respect to the direction of the magnetic needle, or were great circles of a sphere produced by the revolution of the plane of the magnetic meridian about the needle prolonged as an axis.

I had not yet noticed that the meteors all radiated from a point a little south of the zenith. I estimated the distance of that point from the zenith to be from 10° to 15°, and that it was a little east of south. Now the dip of the needle at this place is about 76°. Can there be any doubt then, that the point from which these meteors proceeded, corresponded to that spot in the dome of heavens to which the needle would point, when left free to move both vertically and horizontally? So it then appeared to me: and it struck me that the apparent motions of all the meteors that I saw, might be explained on the supposition that they were passing over portions of great circles or meridians on a magnetic sphere, described about the magnetic needle prolonged to the heavens. They did not all, indeed, begin to be luminous until they had proceeded many degrees from the elevated or south pole of such a sphere: but wherever they first became visible, they seemed to me to be moving towards its northern or depressed pole on meridional circles.

A little reflection, however, will render it obvious that it would make no difference as to the apparent paths of these bodies seen from the earth, whether they actually described such curves as have been mentioned, or moved in straight lines from a great distance towards the earth in a direction parallel to that of the magnetic needle freely suspended; for in this latter case their apparent paths would coincide with such meridional curves; and one fact noticed here favors the idea that they were thus projected in parallel lines towards the earth, and that the distance of most of them when they started, was so great as to coincide with the vanishing point in perspective. Those nearest the point of radiation had generally a very slow motion, slower than in other parts of the heavens, and the apparent velocity, as well as brilliancy, in some cases increased as the meteor receded from the radiant point. In other instances, after a slow motion over a very inconsiderable arc, they disappeared. The inference seems unavoidable that in such cases their line of motion was nearly towards the observer.

The wind on the morning of the 13th, blew hard from the north west, and fleecy clouds, often considerably thick, were frequently spread over large portions of the sky, especially near day light. But in no instance was a meteor observed between the clouds and the earth. Even the train of phosphorescent light, which Prof. Olmsted has described as remaining near the star Capella, and which was gradually folded into an irregular curve like a serpent, and borne eastward by the wind, (as he very probably supposes,) was entirely hidden by a cloud passing over it. Hence we must conclude that the seat of this whole display was above the clouds. Yet if the wind did actually disturb the phosphorescent train of one of these meteors, it must have been within the atmosphere. Another fact, however, stated by Prof. Olmsted, seems to indicate that the radiant point of these meteors was beyond the atmosphere: for he says that this point maintained the same relative position in respect to the fixed stars for an hour or more. Such a westerly motion as this implies, was not noticed here; but I can easily conceive how the vanishing point of these meteors, if they were projected towards the earth, might have been beyond the atmosphere, while the place at which their motion terminated, might have been within it; and in the case above mentioned, the great brilliancy of the meteor renders it probable that it was one of the nearest to the earth.

It was thought by some in this place that they heard the snapping or crackling sound said to have been noticed in other places. I heard nothing of this sort myself: and I confess myself extremely jealous of the accuracy of facts, where there is so much room for the play of an excited imagination.

I know of no other circumstances of peculiar interest in regard to this appearance that were observed here. Feeble health prevented me as I wished from employing any of the accurate magnetic instruments belonging to the philosophical apparatus of the College, to determine the influence of the meteor upon the needle. I hope it has been done in other places, although I can hardly suppose the meteor was near enough to the earth to produce much effect upon the needle.

If now I have not greatly misapprehended the facts in this case, it seems to me that they lead us to infer a very strong and remarkable resemblance between the phenomenon under consideration and the *aurora borealis*. Biot, whose authority on such a subject no one will doubt, in his *Précis Elémentaire de Physique*, as translated by Professor Farrar, thus describes the latter phenomenon. "Furthermore, it sometimes happens, that the phosphoric fires, (of the *aurora borealis*,) breaking forth from all parts of the horizon, from the east, the west, and the north, ascend, or seem to ascend, vertically over the head of the observer, even to his zenith, and having passed this point, they form by their union a brilliant crown, whose centre is situated some degrees lower, near the south east, at least in all places where this remarkable modification of the phenomenon has been observed. But if we determine the apparent position of this crown, either by the aid of astronomical instruments, or by observing what stars are comprehended within it at the time of its formation, we shall find that its centre, in every place where it has been observed, is always situated exactly in the direction of that point in the heavens, to which the magnetic needle is directed, when suspended by its centre of gravity, in such a manner as to admit of its taking its position freely, in obedience to the resultant of the magnetic forces exerted upon it by the terrestrial globe." Again he says, "But from whatever situation these jets (of light) are observed, they always seem to describe arcs of great circles on the celestial dome, and to converge towards that part of the heavens to which the needle points when perfectly free; whence we conclude that they are in reality cylindrical, and parallel to the direction of the needle. But each jet, moreover, presents great varieties of size and lustre, from which we are led to believe that they are, in fact, composed of a great number of shorter cylinders independent of each other, and in part piled one above another. As these indications are noticed throughout the whole region of space where the meteor is visible, we may conclude with geometrical rigor, that it consists of a forest of luminous columns, all parallel to the resultant of the magnetic forces, and of course for short distances, parallel to each other, and suspended at nearly equal heights on different sides of the horizon."

Biot seems to consider it an established fact, that "the phenomenon of the aurora borealis takes place in our atmosphere;" although for the most part it is more elevated than the clouds. He speaks also of a certain arc of light belonging to an aurora borealis which he observed in the Shetland Islands, and which had a progressive motion, and that almost insensible, towards the south-east, whither it seemed to be carried by a gentle north-western breeze that was then blowing."

It will still farther illustrate the resemblance between the aurora borealis and the phenomena under consideration, to make one or two more quotations from Biot, which exhibit the leading principles of the hypothesis proposed by him for accounting for the former on philosophical principles. For whether it be correct or not, its principal conditions correspond remarkably with observation. It was originally proposed by the English philosopher Dalton.

"We may consider this meteor (aurora borealis,") says Biot, "as consisting of real clouds, proceeding usually from the north, and composed of some very light substances, or at least of some substance so finely pulverized as to be capable of floating a long time in the atmosphere, endued with the property of occasionally becoming luminous; and especially (which is very important) sensible to terrestrial magnetism, and spontaneously arranging themselves in columns which turn towards the earth, as real magnetic needles would do. But of all terrestrial substances, only the metals, so far as we know, are in any considerable degree susceptible of magnetism. It is then probable, that the columns of the meteor are at least in a great measure composed of metallic particles reduced to powder of extreme fineness."

"If columns consisting in part of metallic substances are suspended in nearly a vertical position in the atmosphere, like the columns of the aurora borealis when they float over regions adjacent to the pole, the electricity of the atmospheric strata at the summit and base of the columns will find in them so many conductors more or less perfect, and if this tendency of electricity to diffuse itself uniformly is sufficient to overcome the resistance arising from the imperfect conducting power of the columns, it will flow along these columns, illuminating its path, as is often observed in conductors which are not continuous. When this passage takes place in the higher regions of the atmosphere, where the air, on account of its rarity, offers very little resistance, the electricity will flow on silently with all those variations of light which we observe in exhausted tubes. But if it extends itself to the inferior strata, it must necessarily occasion such hissing and crackling noises, as are found to accompany the aurora borealis, when it descends near the surface of the earth."

In the following paragraph one would be led to suppose that the author was describing the same phenomenon as that observed in this country on the 13th instant.

"But, independently of the luminous jets which may thus be produced by the simple passage of electricity along the metallic columns, a passage which in virtue of a property lately discovered, might of itself be sufficient to magnetize these columns; we can hardly help considering the phenomena in question as proceeding from an actual combustion in the phosphoric clouds, which, detaching themselves in some cases from the burning meteor, as affirmed by many observers, and as I have myself seen, transport with them the principle of their phosphorescence, and emit at intervals jets of light resembling rockets, which leave after them a whitish train. We must then regard it as at least a very probable supposition, that the aurora borealis is composed of substances, capable occasionally of inflammation, either of a spontaneous kind, or in consequence of a discharge of electricity from the clouds which contain it."

My object is not to defend this beautiful hypothesis, but simply to show that the resemblances between the aurora borealis and the phenomenon in question are so striking, as to justify us in referring both to the same origin, and regarding them as only modifications of the same appearance. I found this opinion upon three general arguments, deduced from the preceding statements.

First, the optical resemblances between the two phenomena. True, in the meteors observed on the 13th inst. the light was usually concentrated almost to a point, and more vivid than that of the aurora borealis: but no one could fail to perceive a great resemblance to the aurora borealis, in those trains, which the meteors frequently left for some minutes over many degrees of their paths; and we have seen that Biot says, that the aurora borealis sometimes "emits at intervals jets of light resembling rockets, which leave after them a whitish train." Here we see a passage of the two phenomena into each other, in their optical characters. It may not, indeed, be possible in the present state of our knowledge, to show why in the present instance the meteors all assumed originally the appearance of stars. Yet I imagine we can conceive of causes enough to produce such a modification, and thus be prevented the necessity of supposing them to be essentially different in their nature. Was it because these meteors moved in a direction opposed to that of the aurora borealis, and were thus brought into such a situation that we saw them endwise, which would of course greatly increase their brilliancy? Or was it because a greater quantity of the electric fluid was discharged, and in a more concentrated form, owing to a peculiarity in the conducting power of the columns? Or was it because more of Biot's supposed phosphorescent inflammable matter was present and set on fire?

Secondly, the probability, that the distance of the theatre of both the phenomena from the earth was nearly the same. It is generally admitted, as we have seen, that the aurora borealis belongs to the upper regions of the atmosphere: and upon the whole, I think we must admit the same in respect to the recent meteoric exhibition; although one of the facts mentioned by Prof. Olmsted, rather militates against this conclusion. But how else can we explain it, that the wind affected one of the trains from the meteor. And there is another circumstance leading to the conclusion that this was an atmospheric phenomenon. Mr. Ellicott, in his account of a similar appearance in 1799, mentions that it was accompanied, as in the present instance, with a great and sudden change in the weather, from warm to cold, and in the wind, from south to northwest. A similar change we know often precedes, accompanies, or soon follows an unusual display of the aurora borealis. And one can hardly avoid the conclusion, that this change was greatly concerned in the production of the recent meteors; and that therefore, they must have had an atmospheric origin.

Thirdly, the similar relation which both the phenomena have exhibited to the direction of the magnetic needle. This is by far the most decisive argument; if I have committed no mistake as to the fact, and if the optical characteristics be considered as not opposed to an identity of origin.

There is, however, one important circumstance that may be thought inconsistent with such an identity. Admit that in both cases the jets of light moved parallel to the magnetic needle when freely suspended, yet the aurora borealis proceeds from the north towards the zenith: whereas the meteors in the present case had a contrary direction.* The cause of this contrariety we may not indeed, be able to explain: but why should not electro-magnetic exhibitions in the heavens emanate from the south pole of the needle as well as the north? The mystery is, rather, why the corruscations should not as often move from the zenith towards the horizon, as from the horizon towards the zenith. The rarity of the former occurrence, however, ought to lead us to expect some remarkable modifications of the phenomena when it does take place; since a peculiar combination of circumstances is probably necessary to its production.

May we not then be permitted, on the principles of rational philosophy, to regard the splendid meteoric phenomenon which we have recently seen, as a mere modification of the aurora borealis: or rather, might it not be appropriately styled *aurora australis;* and we can hesitate to regard it as an electro-magnetic phe-

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* Their apparent direction, if, as I suppose, they are influenced by electro-magnetic laws, will depend upon the situation of the magnetic needle. Humboldt and Bonpland, in their account of the remarkable meteoric display observed by them in South America, in 1779, state that the direction of the meteors "was very regular from north to south. In an amplitude 60°, the meteors were seen to rise above the horizon at east north-east, and at east to describe arcs more or less extended, falling towards the south, after having followed the direction of the meridian." Very probably these meteors followed the magnetic meridian; although these observers seem to have been unfavorably situated for determining this point. The same phenomenon was observed in the Gulf of Florida, by Mr. Ellicott, in Labrador and Greenland by the Moravian missionaries, and in Germany by M. Zeissing: and the meteors appear to have had different directions in at least several of these places. Whether the differences observed in these respects may not be explained by the great differences in the position of the needle in countries so remote, I have not now the leisure for determining.

nomenon, aided perhaps by phosphorescent and inflammable gases? Such a view of the subject would certainly tend to remove every superstitious fear that may have arisen in any mind, and lead every one, who had the privilege of witnessing the spectacle, to feel thankful, that an experiment so beautiful and magnificent, should have been performed within the lofty and transparent dome of nature's temple, by the display of her hidden energies. It is too rich an exhibition to be repeated to the same generation.

If the conclusions which I have drawn be admitted, I do not see why we may not proceed a step farther; and say that the common shooting stars, which in a clear night are so frequently visible, may be referred to the same causes, and regarded as only modifications of the aurora borealis. For it seemed to me that the meteors that appeared on the 13th inst. bore an exact resemblance in their nuclei, trains and apparent motions, to these erratic stars. Has it ever been ascertained whether their motions have any relation to the direction of the magnetic needle? It is said that the solid meteors, portions of which sometimes fall to the earth have such a relation; but these appear to be entirely distinct from common shooting stars. I hope you will excuse me for saying so much on this subject, and believe me, as ever, respectfully and most truly yours,

EDWARD HITCHCOCK.

P. S. While upon the subjects of meteors, I am reminded that I ought perhaps to make a statement in respect to a gelatinous body of this kind, said to have fallen in this place on the 13th of August, 1819, of which an account is given in Vol. 2. p. 335, of the American Journal of Science, by Rufus Graves, Esq. After I came to reside in this place, I was invited by that gentleman, one damp sultry morning in August, to go to nearly the same place, where the first meteor was supposed to fall, and to examine another, which was thought to have descended the preceding night, and which exactly resembled the first one. It lay upon some half decayed chips of wood, and corresponded in size, color and consistence to that described in the paper referred to; and the action of the acids upon it was the same. But I recognized it in a moment as a species of gelatinous fungus, which I had sometimes met with on rotten wood in damp places, during dog days. And when the surface had not been disturbed, it had a papillose appearance, obviously the result of vegetable organization. I did not satisfy myself as to the genus to which it belonged sufficiently to hazard an opinion. The day being a warm and damp one, I predicted that similar funguses might spring up within twenty four hours; and in fact, two others appeared before the evening of the day, whose vegetable character was still more unequivocal; thus settling the question in my own mind, that there was an entire mistake in regard to the meteor described in the place above mentioned. In justice to Colonel Graves, however, I ought to say, that under the circumstances of the case, the mistake was very natural, nor should I take the pains to correct it, had I not noticed that his account was referred to, as correct, in some of the European Journals.

Amherst College, Mass. Nov. 28, 1833.

Art. XIV.—*Observations on the Meteors of November 13th*, 1833; by Denison Olmsted, Professor of Mathematics and Natural Philosophy in Yale College.

The morning of November 13th, 1833, was rendered memorable by an exhibition of the phenomenon called shooting stars, which was probably more extensive and magnificent than any similar one hitherto recorded. The morning itself was, in most places where the spectacle was witnessed, remarkably beautiful. The firmament was unclouded; the air was still and mild; the stars seemed to shine with more than their wonted brilliancy, a circumstance arising not merely from the unusually transparent state of the atmosphere, but in part no doubt from the dilated state of the pupil of the eye of the spectator, emerging suddenly from a dark room; the large constellation Orion in the southwest, followed by Syrius and Procyon, formed a striking counterpart to the planets Saturn and Venus which were shining in the southeast; and, in short, the observer of the starry heavens, would rarely find so much to reward his gaze, as the sky of this morning presented, independently of the magnificent spectacle which constituted its peculiar distinction.

Probably no celestial phenomenon has ever occurred in this country, since its first settlement, which was viewed with so much admiration and delight by one class of spectators, or with so much astonishment and fear by another class. For some time after the occurrence, the

"Meteoric Phenomenon" was the principal topic of conversation in every circle, and the descriptions that were published by different observers, were rapidly circulated by the newspapers, through all parts of the United States.

The writer of this article, through the kindness of a friend, was awaked in season to witness the spectacle in much of its grandeur. His impressions were immediately committed to writing, and the statement was published the same day in the New Haven Daily Herald. It concluded with a request for information from other observers. Although he did not presume to expect communications, except from observers within the limited sphere through which the paper circulates, yet the article being copied into other papers of a wider currency, the request has met with a response from scientific gentlemen residing in different parts of the Union, to whom he tenders his grateful acknowledgments. By their kindness, added to a diligent perusal of the public papers, and of various statements from the correspondents of this Journal, which the editor has been so good as to place in his hands, (of which notices will appear in the sequel,) he believes himself to have the means of giving a synopsis of the principal facts as observed throughout the United States, in some of the neighboring islands, and on parts of the ocean, although it is still too early to attempt a description of this phenomenon in its full extent; for we have not yet had time to hear of its extreme limits in any one direction, or of the appearances which portions of the heavens are presumed to have presented to places situated without those limits. But if we should venture no farther, we may at least render an acceptable service to science, by collecting and classifying the facts already ascertained, and recording them in a work more permanent than the ephemeral publications, in which they have hitherto appeared.

It is proposed then, first, after describing the phenomenon as it appeared at this place, (Yale College,) to insert at large several descriptions furnished by observers residing in places remote from each other; secondly, to present a synopsis of all the facts hitherto ascertained; thirdly, to offer a concise sketch of similar phenomena heretofore observed and recorded; and finally, to inquire what explanation, if any, may be given to the phenomenon in question.

I. Descriptions.

1. Phenomena as observed at *New Haven*, (Lat. 41° 18′ N., Lon. 72° 58′ W.) and published in the New Haven Daily Herald.*

"About day break this morning, our sky presented a remarkable exhibition of Fire Balls, commonly called *Shooting Stars*. The attention of the writer was first called to the phenomenon about half past five o'clock;† from which time until near sun rise, the appearance of these meteors was striking and splendid, beyond any thing of the kind he has ever witnessed.

To form some idea of the phenomenon, the reader may imagine a constant succession of fire balls, resembling sky rockets, radiating in all directions from a point in the heavens, a few degrees south-east of the zenith, and following the arch of the sky towards the horizon. They commenced their progress at different distances from the radiating point, but their directions were uniformly such, that the lines they described, if produced upwards, would all have met in the same part of the heavens. Around this point, or imaginary radiant, was a circular space of several degrees, within which no meteors were observed. The balls, as they travelled down the vault, usually left after them a vivid streak of light, and just before they disappeared, exploded, or suddenly resolved themselves into smoke. No report or noise of any kind was observed, although we listened attentively.

Beside the foregoing distinct concretions, or individual bodies, the atmosphere exhibited *phosphoric lines*, following in the train of minute points, that shot off in the greatest abundance in a north-westerly direction. These did not so fully copy the figure of the sky, but moved in paths more nearly rectilinear, and appeared to be much nearer the spectator than the fire balls. The light of their trains also was of a paler hue, not unlike that produced by writing with a stick of phosphorus on the walls of a dark room. The number of these luminous trains increased and diminished alternately, now and then crossing the field of view like snow drifted before the wind, although in fact, their course was towards the wind.

From these two varieties, the spectator was presented with meteors of various sizes and degrees of splendor: some were mere points, but others were larger and brighter than Jupiter or Venus; and one, seen by a credible witness before the writer was called, was judged to be nearly as large as the moon. The flashes of light, although less intense than lightning, were so bright as to awaken people in their beds. One ball that shot off in the northwest direction, and explo-

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* The substance of this sketch is the same as that published in the New Haven Herald, on the day of the occurrence; but as that sketch was drawn up in haste, careful reflection has since suggested a few additions and alterations of phraseology, with a view of rendering the statement more explicit.

† Apparent time, or *a quarter past five*, mean time.

ded a little northward of the star Capella, left, just behind the place of explosion, a phosphorescent train of peculiar beauty. This line was at first nearly straight, but it shortly began to contract in length, to dilate in breadth, and to assume the figure of a serpent drawing itself up, until it appeared like a small luminous cloud of vapor. This cloud was borne eastward, (by the wind, as was supposed, which was blowing gently in that direction) opposite to the direction in which the meteor had proceeded, remaining in sight several minutes. The light of the meteors was usually white, but was occasionally prismatic with a predominance of blue.

A quarter before six o'clock, it appeared to the company that the point of apparent radiation was moving eastward from the zenith, when it occurred to the writer to mark its place, accurately, among the fixed stars. The point was then seen to be in the constellation Leo, within the bend of the sickle, a little to the westward of Gamma Leonis. During the hour following, the radiating point remained stationary in the same part of Leo, although the constellation in the mean time, by the diurnal revolution, moved westward to the meridian nearly 15 degrees.* By referring to a celestial globe, it will be seen that this point has a right ascension of 150 degrees, and a declination of about 21 degrees. Consequently, it was, when on the meridian, 20 degrees 18 minutes south of the zenith.

The weather had sustained a recent change. On the evening of the 11th, a very copious southerly rain fell, and on the 12th, a high westerly wind prevailed, by gusts. Last evening the sky was very serene; a few "falling stars" were observed, but they were not so numerous as to excite particular attention.

The writings of Humboldt contain a description of a similar appearance observed by Bonpland, at Cumana, in 1799. It is worthy of remark, that this phenomenon was seen nearly at the same hours of the morning, and on the 12th of November.

Yale College, Nov. 13, 1833."

2. Phenomena as observed at *Boston*, (Lat. 42° 21′ N. Lon. 71° 4′ W.) and published in the Columbian Centinel.

"This morning there was the appearance of a thick shower of fire. It was occasioned by the incessant falling of innumerable meteors commonly called falling or shooting stars.

Having risen as usual at 4 o'clock, I thought I observed several very bright falling stars, but as the window was covered with steam,

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* Aware of the importance of this fact to the question whether the origin of the meteors was terrestrial or not, the writer remarked it with much interest; but the advancing light of day rendered his means of observation imperfect, and he therefore felt it necessary to rely on those who saw the phenomena earlier and longer, for a confirmation of it, if the fact was so. Accordingly, in the paper of the succeeding day, he inserted a special request for information respecting this point. The same request has been addressed to observers in several places remote from each other: the result will appear in the sequel.

in consequence of the change of temperature out of doors during the night, I saw but indistinctly, and took my box to strike a light without seeing or thinking more of the phenomenon, until I went down to the parlor twenty minutes before six o'clock; except that twice I saw a very sudden and bright glare of light, which, at the time, I supposed must have come from some lamp or fire in the house opposite. On opening one of the parlor shutters, I was surprised at seeing innumerable meteors similar to those commonly called shooting stars. They were moving in a direction downward, and I should say, according to the best judgment I could form, were falling about half as thick as the flakes of snow in one of our common snow falls, with intervals of a few seconds, when there was not so many.

I stood observing the phenomenon till fifteen minutes before six, at which time, the meteors being fewer, I attempted to count a portion of them. In the part to which my attention was confined, and which was perhaps a tenth part or rather less of the horizon, I counted 650 stars, during the fifteen minutes before six o'clock. They fell so fast and thick, however, that I supposed I was not able to enumerate thus distinctly, more than two thirds the number of those which actually fell during that time in the space to which my attention was directed. If I am correct in my estimation, this would show the number of meteors falling during the fifteen minutes, to have been more than 8660. At 6 o'clock, I went to the top of the house. The phenomenon was now beginning to cease. During the first fifteen minutes after six, the number which fell in the southern half of the heavens from the zenith downwards was 98. The last fell ten minutes before sunrise.

In the course of this time there were two exceedingly bright meteors. I did not see them, as they did not make their appearance in the part to which my attention was directed; but the steeple of the neighboring church was reddened by the light of them; and I then supposed that the glare of light in my chamber, which I had before attributed to a lamp or fire in the house opposite, must have proceeded from meteors.

The sky was clear excepting on the verge of the horizon, where in the east, there were a few thin streaks and small specks of clouds, and in the south and southeast, the round heads of a range of dark heavy clouds were just visible above the horizon.—There was however, a vapor in the atmosphere, visible round the horizon, which in the southeast assumed a very beautiful appearance during ten minutes, about half an hour before sunrise. The thermometer yesterday at 2 P. M. was 63 deg.; this morning at 4 o'clock, it was 39 deg. There was but little wind, and this from the west. The direction in which the meteors moved was almost directly downward, and not oblique as usually seen, except in two instances, when the course was horizontal, nearly in a straight line, and from northeast to southwest, and these two meteors were high and small. Generally the meteors appeared to be very low in the atmosphere, some to come down apparently almost to the house tops. They all had a distinct nucleus, generally about half the size of Jupiter, some were larger than this, some smaller, and a few were larger than the apparent disc of Jupiter. They all left luminous white traces, bands, or tails, which generally appeared to be, in popular language, about a yard in length; a few were three times and some not more than half this apparent length.—Their appearance continued in most cases from three to four seconds, some five, not many, if any, longer than this. There was no appearance of explosion or bursting to the nucleus of any of them.

I have never met with any account of such a phenomenon having been observed in this country before. Similar phenomena have occasionally been presented elsewhere, and have been spoken of as Showers of Fire, to which indeed this bore a perfect resemblance. One instance occurred about eighty years since in South America. This was witnessed at Quito, where so many falling stars were seen, above the volcano of Gayambo, as led the inhabitants to imagine the mountains to be in flames. The people assembled in the plain of Exico, and a procession was about to set out, in consequence, from the Convent of St. Francis, when they discovered the phenomenon to be occasioned by meteors which, as we are told, ran along the skies in all directions. A more extensive and remarkable phenomenon of this kind occurred in the night of the 12th of November, 1799. Of this appearance as it was seen at Cumana, an accurate account has been given by M M. Humboldt and Bonpland. It occurred towards the morning when, we are informed thousands of meteors, bolides, fire-balls, or falling stars, as they were variously denominated, suceeded each other during four hours. Their direction was from North to South. They rose in the horizon at east-north-east, followed the direction of the meridian, and fell towards the South. There was little wind, and this from the East. No trace of clouds was seen. There was not a space in the firmanent equal in extent to three diameters of the moon which was not filled with burning stars. They were of different sizes. They left the luminous traces of from five to ten degrees in length. The appearance of these traces continued seven or eight seconds. Many of the stars had a very distinct nucleus as large as the apparent disc of Jupiter. The largest were from 1° to $1^{\circ}\ 15'$ in diameter. They are described as seeming to burst as by explosion. Their light was white. They were seen by almost all the inhabitants of Cumana, the oldest of whom asserted their remembrance that the great earthquakes of 1766, were preceded by similar phenomena. The fishermen in the suburbs said the *fire work*, as they call it, began at one o'clock. It ceased by degrees, after four, but some of the meteors were thought to be seen a quarter of an hour after sunrise. Such meteors are said to be rarely seen there after two in the morning. This phenomenon was observed by some Franciscan Monks near the cataracts of Oronooko, and by others at Marao, one hundred and seventy-four leagues from Cumana, by some of whom, as was afterwards found, the day had been marked in their ritual, and by others had been noted by the nearest church festival; they all compared it to a beautiful firework. Indeed this phenomenon was ascertained to have been observed on an extent of the globe, equal to 60 deg. of latitude and 91 deg. of longitude, at the equator in South America, at Labrador, and in Germany."

3. Phenomena as observed at *West Point*, (Lat. 41° 24′ N., Long. 73° 57′ W.,) by Mr. Alexander C. Twining, Civil Engineer.

"West Point, Nov. 15th, 1833.

To Prof. Olmsted.

Dear Sir,—I presume that you will be glad to receive from various quarters, observations upon the brilliant and wonderful phenomenon which appeared in the skies, on the morning of Wednesday the 13th. It was not my fortune to witness it from the beginning; but I observed it for more than an hour, from a few minutes past five o'clock, by the watch, till the morning light made it no longer visible. There is little doubt that it had been in progress for hours, before my first glimpse of it. I shall describe only those things which passed under my own notice.

The air was very clear; and there was a perceptible and constant light like twilight, given out from the numerous luminous bodies which were in motion in the sky above. Of these bodies, a host of which were darting out on every side and at every altitude, the greater multitude were like stars suddenly lighted up in a state of rapid motion shooting a certain distance and gone in a second; leaving where they had passed a luminous trace, resembling commonly a filament of white or yellowish white cloud, of sensible breadth in the middle, but tapering to a point at each extremity like two very acute triangles united at their bases; and these luminous traces, like dissolving nebulæ, gradually faded and were indiscernible after a few seconds. A second class of luminous bodies, larger in diameter but equally transient in continuance, and less frequent, shot along like falling lamps, followed by a small short and pointed flame so brilliant as to pain the sight for an instant. In sensible magnitude these might be compared to the morning star, and in intensity of brilliance to lightning. Occasionally, a bright flash like moderate or distant lightning, indicated the developement of a still larger body. One which fell vertically to the west of north I had in full view. It was a deep red fiery ball of perhaps one fifth the moon's apparent diameter, which descended down to the visible horizon, and left its path of a few degrees in extent luminous and striped with prismatic colors;—my impression is that one edge through all its length was red, and the other a greenish blue. It was occasionally the fact that prismatic colors were developed in the trace of those smaller bodies which I have described; and about the time when the morning light was beginning to make the fainter phenomena invisible, I could observe many of a faint but decided green.

There was a point a few degrees south and east of the zenith, which was evidently the *directrix* of all the apparent motions; and every luminous body, without exception, of those associated in the phenomenon, obeyed a regimen in relation to that point, which was such that every line and track of motion if continued backward, would have passed, as nearly as the eye could discern, through that specific point. In the vicinity of that point, a few star-like bodies were observed possessing very little motion and leaving very little length of trace; but, in their aspect, such as if a small nebula had softly swelled out from the heavens, gently elongated in its figure, and then as gently subsided. Farther off the motions were more rapid and the traces longer; and most rapid of all and longest in their trace, were those which originated but a few degrees above the horizon and descended down to it. In these, the aspect might be compared to that of flaming sparks driven swiftly athwart the sky by a strong wind.

The position in the heavens of the point which I have described, might have been determined with much nicety by an attention devoted exclusively to that determination; but in the variety of aspects which solicited notice, I did in fact only make a rapid and general determination; the result of which was to place it between the stars in the breast and shoulders, and those in the head of the Lion. As a definite point, I should select as near the truth a small star in the Lion's neck, which I find on the celestial globe at the bisection of a line from ε to γ, and also nearly at the bisection of a line from μ to η of that constellation; and I should call the time of the observation half past five o'clock mean time. This point then lay at about the elevation of the magnetic pole, but too far east of the meridian. I trust that some one who had earlier and better opportunity for accurate observation, may have made the same determination with precision. This point, of which mention has been made, cannot be supposed to have been a real part of space from which the luminous bodies actually proceeded, but the vanishing point of sight for motions which were truly or nearly parallel. If a multitude of bodies moving in parallel directions had entered the earth's atmosphere from that quarter of the heavens which has been pointed out, and become luminous by contact with the atmosphere, and had been dissipated by motions through it, they must have presented the apparent motions, very nearly, if not exactly, as those which I observed. The supposition is not suggested as a possible explanation of the facts, but as a guide to the conceptions of such as did not witness the phenomena, and may desire to have a clear idea of what they were. For, in the case supposed, if any luminous body were moving directly in the axis of vision, it would have appeared and vanished like a star without any apparent motion. Those which were near the axis of vision, would present the short trace and gentle motion of the nebulæ described above; but according as that distance became greater, the apparent motion would be more rapid and the trace longer; and all the traces would be seen in directions diverging from the point in which the axis of vision met the heavens.

These bodies did not seem to bear affinity to those meteors which revolving around the earth as their primary, become ignited by passing into the atmosphere, and explode throwing down masses to the surface; but to those shooting stars and fire balls which are often seen in the sky in the evening, and which, I am now persuaded, might all be found capable of being referred as to their line of motion to a determinate point.

The number of shooting bodies which passed in the heavens on the morning of the 13th inst., must be the subject of conjecture to a considerable extent: I should not deem it extravagant to suppose ten thousand to a single hour, during the period of my observations.

I will only add, that the morning was cool, and probably not far from freezing temperature; and there was a moderate breeze from the north of west. The day preceding had been marked by sudden and violent gusts of westerly wind, one of which threw over and sunk opposite to this place a two masted vessel, with such suddeness, that all on board perished.

I am, Sir, yours with sincere respect, ALEX. C. TWINING.

P. S. Since writing the above, I have accidentally seen in a volume of Maskelyne's Observations, that the streams of a bright aurora in 1769, Oct. 24th, at 21*h* 58′ sidereal time, converged to a point about 21° East of South in azimuth, and 17½ from the Zenith, which he remarks *to be about the magnetic pole*."

4. Phenomena as observed at *Annapolis*, (Lat. 39° N., Lon. 76° 43′ W.) Communicated to Professor Olmsted by the writer, Rev. Dr. HUMPHREYS, President of St. John's College.

" A remarkable phenomenon of *shooting stars* was seen at Annapolis, about 4 or 5 o'clock, on the morning of Wednesday, the 13th instant; the number of the meteors was far greater than in any former instance ever observed by the writer. They all appeared to move from a common centre, at or near the zenith; and at times, they completely filled the whole heavens, particularly towards the East, with beautiful brilliant streams of light, extending to the horizon. It is not meant that all the trains actually extended from the zenith to the horizon; but that the lines of light were *so directed*, that if *produced*, they would all converge to a point in the zenith. Their appearance was so incessant during some part of the phenomenon, that all the stars of the firmament, seemed to be darting from their places. Many persons thought a shower of fire was falling, and became exceedingly alarmed. The light was so intense, that apartments, where persons were sleeping, were strongly illuminated, and some were aroused under the apprehensions that their dwellings were in flames. It prevailed most for about an hour before the dawn of day. It is known to the writer, that numbers of shooting stars were seen as early as 2 o'clock, in the morning. The phenomenon must have continued therefore more or less vividly, for four or five hours. During the period just previous to the dawn, it was observed by many intelligent persons in this city, whose statements coincide most perfectly, as to the *almost infinite number* of the meteors. In the words of most, they fell, *like flakes of snow.* They appeared to the writer himself, just after the dawn, in almost incessant gleams; but the spectacle, at that time, must have lost much of its magnificence.—Those who saw it to the best advantage, agree as nearly as could be expected, considering that it is often necessary, in such cases to make some allowance for extraordinary excitement. It is well ascertained that several of the meteors appeared to burst into numbers of smaller stars, as they fell; and it is said that some were seen to fall upon the earth and to rebound into the air. As no vestiges, however, have been discovered upon the ground, it may be presumed that this was an optical deception. From the same cause the accounts differ, as to *the size* of some of the meteors. One, in particular, is stated by several, to have been as large as the moon, while to others it appeared considerably smaller. So also, the most brilliant of them, was said by some, to have been visible for more than a minute, though it could not, probably have continued longer than a few seconds. It is evident, notwithstanding, that this meteor was of an uncommon size, and that it was seen much longer than is usual for these transitory scintillations. It is certain that one of the *trains* remained faintly visible for about thirty seconds. No audible explosion so far as we can learn attended any of the meteors. It was as it were, a perfectly *silent and simultaneous dance of the stars.* It is probable, that the phenomenon was seen over a wide range of the country. A gentleman from several miles beyond the Severn, saw the meteors at his residence, in as great abundance as they occurred here. The steamboat Maryland, also, being about to leave Cambridge, on the eastern shore, the hands were up at an early hour, and the observations of the captain and of all on board, agree substantially with what was witnesssed at Annapolis.

Notwithstanding the strong persuasion of several observers, that the meteors fell upon the ground, the writer is convinced that their paths were in the upper and rarer strata of the atmosphere, since optical principles show that in darting away to the horizon, they would *appear* to descend and to strike into the earth. The usual theory of the inflammable gases, which have been generally supposed to account for these meteors, does not appear to explain the phenomena. If we admit that the gases are generated and diffused sufficiently to kindle up the whole heavens with light, the combustion of them would not present those *innumerable distinct sparks*, which shot from the region of the zenith, with such *perfect uniformity of direction.* This last circumstance was in fact, the most remarkable point, in the whole phenomenon, so far as it was seen by the writer. To him, it appeared to resemble a *constant succession* of *vivid, electrical* or *magnetic sparks*, presenting all the peculiar colors seen in the beautiful experiments upon those fluids, or perhaps more accurately, that fluid to which magnetism and electricity are attributed. It is believed, the appearances in question, were owing to a sudden atmospheric change, which took place, on the evening of the day previous. The weather had been unusually warm, during the morning of Tuesday; but in the evening, it was cold, and even keenly so, while the stars were shooting, as also, for the whole of the following morning. A strong wind prevailed at Annapolis, for the greater part of Tuesday, and also, during the middle of the day following; but at the time of the meteors, the air was tranquil. The wind on Tuesday, blew from the south, at first, but veered suddenly and for the rest of the day, was quite fresh from the northwest; and on Wednesday it blew nearly as strong, but not so cold, from the south. The sky was unclouded, and the general state of the atmosphere was such as usually accompanies the appearance of the Northern Lights." (Annapolis Republican.)

5. Phenomena as observed at *Emmittsburg*, Maryland, (Lat. 39° 40′ N., Long. 77° 10′ W.,) by W. E. Aikin, M. D., Professor of Chemistry and Natural Philosophy in Mount St. Mary's College, (from a Maryland paper.)

"My attention was called to the heavens about half past four in the morning, to observe an unusual number of the meteors known generally as shooting stars, that were then visible. From the number constantly in sight, and from the frequency and splendor of their corruscation, the scene was altogether brilliant beyond conception. Instead of the usual intermediate course of such meteors, these described paths in the direction of radii diverging from a central space. This point was in the neck of Leo, near the star Gamma of that constellation, and at the hour of half past five, a little to the south and east of the zenith. It was of no great extent, not longer perhaps than a circle ten degrees in diameter, without accurately defined outlines, but perfectly clear. From this center as a radiating point, proceeded the meteors in numbers exceeding the visible stars, and in intensity of light often rivalling the rays of the full moon. All did not originate in the immediate vicinity of the center: more became first visible, between that and the horizon; but all proceeded in nearly regularly radiating lines. None were visible for more than a few seconds, although their luminous trains remained sometimes much longer. These trains were straight lines of light, except upon a few occasions they appeared tortuous. All the meteors were not equally brilliant, varying from points and lines barely perceptible, to broad flashes of light, sufficient to cause distinct and well defined shadows. No noise of any kind accompanied them, that I could distinguish, nor did I observe any thing like scintillations, as indicating explosions.

It would be difficult for one who had not witnessed the grand exhibition, to conceive the effect of this uninterrupted succession of innumerable meteors, proceeding from a point so nearly vertical towards the whole circumference of the horizon, and this too during the stillness of night, and with an atmosphere perfectly transparent. It could only be compared to one grand and continued discharge of fire works, occupying the whole visible heavens. It is difficult to say how long these appearances lasted. They were first observed by a gentleman of the college about 3, A. M. and from that time till the light of approaching day overpowered their own, they continued without intermission.—The most light was observable at the instant preceding their complete extinction; then they seemed to blaze out, as it were, and vanish,—generally disappearing before reaching the horizon, though occasionally seen sinking beneath it with undiminished splendor. Their light was peculiar, but similar to what has heretofore been noticed on analogous occasions—white, with a tinge of blue, comparable to nothing more nearly than that of the flame of burning zinc. A good refracting telescope, directed to the center whence the radii diverged, discovered nothing peculiar. While directing the glass to other points, many of the meteors darted across the field of vision; but their relative motion over so small a space was too rapid to admit of satisfactory examination. If any thing could be inferred from their apparently increased size and light, as seen in such a hurried manner, it would be their probable proximity. In reference to the nature of these luminous bodies, it was the prevailing opinion of those who witnessed them that they were solid masses. All writers on the subject have appeared willing to admit a difference, although that difference is difficult to prove, between solid meteorites which at different times have fallen from the heavens, and those appearances known as shooting stars, visible every night in the year. It appears to me most probable, since probabilities only are attainable on this subject, that this difference is real, and that there may sometimes occur in the upper regions of the atmosphere, what we know takes place nearer the surface of the earth—the production and ignition of gaseous matter. If it is objected that we are ignorant of any gas that would produce such results, I would answer, this is no objection, as long as we are ignorant of the composition of the Will-o'wisp, and similar meteoric lights, so often seen over low grounds.—Those who prefer it, however, will consider all meteors as solid masses, and will then have the liberty of regarding them as the exuviæ of lunar volcanoes, or perhaps as juvenile terrene comets—or lastly, if preferable, they may in the words of an author remarkably perspicuous upon other subjects, suppose them "to arise *from the fermentation of the effluvia of acid and alkaline bodies, which float in the atmosphere.*" A profound thinker has said, "He that knew not what he himself meant by learned terms, cannot make us know any thing by his use of them, let us beat our heads about them ever so long." So I advise you not to beat your head long about the latter supposition. W. E. A. Aikin."

6. Phenomena as observed at *Frederick*, Maryland, (Lat. 39° 24′ N. Lon. 77° 28′ W.,) first published in the Frederick Citizen, and communicated to Professor Olmsted by the writer, Mr. Virgil H. Barber.

"Yesterday morning I observed the most brilliant phenomenon of nature I ever witnessed. The heavens appeared filled with what struck me at first as sparks of fire flying with great rapidity towards every point of the horizon.—This was about half past 5, A. M. After looking attentively for a short time, I perceived that these fiery globules all diverged from the same point, and generally, if not always, vanished in a luminous trail of a peculiar and beautiful blue and white light. One of these in the direction of N. E. near the star Cor Caroli, assumed the form of a serpent with the head very distinct, and a protuberance in the middle of the body. It writhed with the tortuous motion peculiar to that reptile, and continued visible, as I estimated the time, from 3 to 5 minutes, and at last terminated in a broad luminous nebula. The point in the heavens that seemed to form the focus of these rays, if we call them such, was the neck of the lion in the constellation Leo. This focus was several degrees in diameter, if we judge from the fact that when these bodies of light appeared within that space, they were not projected like the others in any one direction towards the horizon, but either were elongated, forming two opposite points, or disappeared in the position in which they first showed themselves. I could distinguish no report even from the largest of these bodies, though their light was sufficient to cast a faint shadow. The whole phenomenon terminated only by being merged in the broad light of day. Travellers and others, I am told, report that it commenced about two o'clock.

There was a slight repetition of it this morning, and from the same point in the heavens. If this radiating point shall have been accurately observed in distant parts of the United States, it may form data for calculating the height of these luminous bodies; which is a question highly desirable to be solved.—My crude conjecture is that their elevation from the earth was very great; and consequently that their velocity was inconceivably rapid."

7. Phenomena as observed at *Lynchburg*, Virginia, (Lat. 37° 30′ N., Lon. 79° 22′ W.,) by Mr. F. G. Smith, (from a Lynchburg paper.)

"*Messrs. Editors*,—On this morning, (Nov. 13) between 2 o'clock and daybreak, we were presented with a most beautiful display of electrical excitement in the upper regions of the atmosphere, probably not excelled in interest by the similar meteoric phenomenon of Nov. 1802.

At 10 o'clock last night, I was struck with the uncommon transparency of the atmosphere and brilliance of the stars. Soon after having my attention thus called to the peculiar state of the air, I felt a slight repetition of the tremulous motion of the earth, which has repeatedly been observed in this vicinity of late.

The *shooting stars*, of which we had so impressive an exhibition this morning, made their first appearance in our hemisphere between 2 and 3 o'clock, but I did not notice them until about 5 o'clock. From the vast number and brightness of the meteors, the sight was, at that time, indescribably beautiful. Their general course was from the southeast to the northwest, most of them appearing to the southwest of our zenith. They first came into view 20 or 30 degrees to the east of our celestial meridian, and extended their flight 40 or 60 degrees to the west of it. Their general motion was probably horizontal, although, from the position of the observer, they seemed to fall. Their path was marked by a train of light which was most brilliant near the point of their disappearance, continuing from 3 to 7 or 8 seconds, and sprinkling the heavens with long, bright dashes of light, resembling in their form the marks made on the window, by the first drops of a shower driven against the glass. The color of the light was generally a pure white, but sometimes tinged with a reddish hue; and so great was the number and frequency of the meteors, as to illuminate the night sensibly, though slightly. The average flight of each ball was over an arc of 50 degrees. The phenomenon was the most brilliant to the south and west of Lynchburgh, at an elevation of from 30 to 60 degrees. The meteors vanished from sight without a visible or audible explosion, and for the most part without scintillations.

No appearance of the Aurora Borealis was observed, nor the slightest vapor of any kind. The air continued as on the evening before, entirely pellucid.

At half past 6 o'clock, the thermometer stood at 54 degrees, Far.; the barometer at 29 inches and 4 tenths, and the hygrometer about

28 degrees. No change was noticeable in the magnetic dip, variation or intensity. Gold leaf electrometers were excited by a touch; Bennett's, placed on the prime conductor, with the cushion insulated, rose on a slight motion of the machine. The pendulum of De Luc's *dry pile* was accelerated. Your most ob't serv't,

F. G. Smith."

Lynchburgh, Nov. 13.

8. Phenomena as observed at *Worthington*, Ohio, Lat. 40° 4′ N., Lon. 83° 3′ W., (from the Ohio State Journal.)

"This morning an hour or two before day, our sky presented a most singular display of luminous meteors. The appearance I am informed commenced at least as early as half past three o'clock, though it was an hour later, when I first saw it; and it continued without intermission, until the light of day rendered it invisible. A numberless multitude of shooting stars, were constantly marking the cloudless sky, with long trails of light. As seen from this place, they seemed to proceed from a point in the heavens, a little west of *Delta*, in the constellation *Leo*. This observation was made at five o'clock. From this point, they appeared to shoot with great velocity down the concave sky, losing themselves on the dark blue expanse, or disappearing in the faint and undefined mist, that rested on the horizon. They were not generally visible in their course, through a greater arc, than 20 or 25 deg.: and those which seemed to approach nearest the horizon, first made their appearance not far above it; while those that commenced their course near the center of radiation, uniformly disappeared before they reached the misty part of the atmosphere. Each meteor in its course left a pale phosphorescent train of light, which usually remained visible for some minutes. Occasionally, one would seem to burst into flames, and burn with increased energy, illuminating the face of terrestrial nature, with a degree of brightness and splendor inferior only to sunshine. But this effect would be of merely momentary duration: for the substance of the meteor would be rapidly consumed, leaving a broad luminous way, which would perhaps remain distinctly visible for twenty minutes; while the wind or some other cause would appear to waft it gently eastward, so modifying its form as to give it the irregular outline of a cloud.

If observations have been made at different and distant places, I think it will be determined, that these subtile and mysterious bodies (if bodies they be) first became visible in the aerial regions, high above the grosser strata of our atmosphere. As witnessed from this place, (the latitude of which, is 40 deg. 4 min., longitude 6 deg. from Washington,) they seemed to diverge from a common center, located some ten or fifteen degrees southeast from the zenith. But I have no doubt, this apparent divergence was an illusion, and that their true courses were nearly parallel. A luminous spot or ring, would frequently appear for a moment, near the point from whence they seemed to emanate; which was unquestionably occasioned by a coincidence of the course of the meteor with the line of observation.

Respecting the origin of these meteors, let him speculate who pleases; for until the boundaries of human knowledge shall be enlarged, vague and inadequate hypotheses, are probably all that can be advanced. When man shall have explored the secrets of the boundless, and seemingly empty regions of space, which encompass the earth, then may he assign causes for phenomena, that now seem veiled in mystery. In speculating on the nature and origin of shooting stars, they must not be confounded with those ponderous fire balls, which, at intervals of years perhaps, sweep across the heavens, and light up the repose of night, with the effulgence of day; spreading consternation and wonder wherever they are seen, and ultimately falling and burying themselves in the earth. Those bodies, are probably the wrecks of small spheres, which, from the earliest ages of nature, have pursued a trackless orb around the earth, moving beyond the subtile confines of the atmosphere; and set on fire perhaps in their fall, by the dense strata of air they encounter, reacting with the spontaneously inflammable materials of which they in part consist.

The solid *nuclei* of these meteorolites, have frequently been examined by the chemist; but the same cannot be said of falling stars. They do not seem to be of a nature so substantial: for it would appear, that they seldom or never reach *terra firma*, but dissipate themselves in vapor or mist, while yet high in the atmosphere.

It is quite probable, in my opinion, that this display of meteors has been observed in different places, over a widely extended region. This, however, remains to be determined. J. L. R."

9. Phenomena as observed at *Salisbury*, N. Carolina, Lat. 35° 39′ N., Lon. 80° 25′ W., by Ashbel Smith, M. D., (Communicated to Prof. Olmsted.)

"Travelling on a professional visit, I was in the open air, without any intermission from night fall till the day dawned. In the early part of the night, the atmosphere was uncommonly bright and even glittering. A few meteors of inferior brightness, in remote regions of the atmosphere, were seen by me previously to midnight; some as early, I feel pretty confident, as 10 o'clock. After midnight, they rapidly increased in number and brilliancy till 4 o'clock. The display was then in the highest degree magnificent and imposing, and continued without diminution till the dawn of day, every region of the atmosphere all the while presenting the sublime spectacle of a shower of fire. The meteors varied greatly in the degree of splendor, some being an obliquely luminous line, while others resembled a rushing ball of liquid fire, with a splendid train or tail, bathing the surrounding objects in a flood of most gorgeous but mellow light."

In a subsequent communication, dated Nov. 30th, Dr. Smith adds the following remarks.

"In this section of country, the meteors, though mostly appearing to descend, did not radiate from any single or several points of the sky. Some few crossed the vertical meridian nearly at right angles; many started at least 100 degrees from each other, in every quarter of the heavens. My own careful observation is confirmed in this particular by that of many intelligent witnesses of the phenomena, with whom I have conversed. Not one of them even suggested the idea of their radiation from a central point or region. Although the progress of the meteors, especially of the larger ones, appeared to be suddenly arrested, I do not recollect seeing any explosion and scattering of the fragments, in the form of lesser meteors, like the bursting of a sky rocket, a phenomenon I had often witnessed previously to the night of the 12th.

By far the most magnificent meteor seen on the morning of the 13th, in this vicinity, crossed the vertical meridian about 3 o'clock, A. M. Its course was nearly due west, in length by conjecture, about 45°, and at a distance of about 25° south from the zenith. In size, it appeared somewhat larger than the full moon rising. I was startled by the splendid light in which the surrounding scene was exhibited, rendering even small objects quite visible; but I heard no noise, though every sense seemed to be suddenly aroused, if I may so speak, in sympathy with the violent impression on the sight. Nor did I at any time hear any aerial noises. It is proper however to add, that although I was very attentive, the movement of my sulkey would have rendered slight sounds inaudible. The track of the meteor adverted to, was visible at least twenty minutes, or, forming my estimate from the distance I travelled the while, I should rather say, half an hour. It assumed successively the following shapes, ,

and finally that of a small irregular luminous cloud. I greatly regretted my want of instruments for taking the altitude of this track. By its continuing to have a southern declination from me when first and last seen, (my course in travelling happened to be towards it, and in the same plane) I concluded it was probably several miles high. I am aware however that a small current of air would effectually destroy such loose calculations.

Previously to the 13th, the atmosphere had been for several days, a little hazy, mild, and quite genial, without rain. In the progress of the meteoric display, the air became very perceptibly more dry, harsh and elastic; this state of it rapidly increased, and on the 15th it was very keen, and cold, with high, dry winds, circumstances which were very favorable to the developement of artificial electricity."

10. Phenomena as observed near *Augusta*, Georgia, Lat. 33° N. Lon. 82° W., (from the Georgia Courier.)

"*Mr. Editor*,—To those of your readers, who had not the good fortune to witness the late meteoric phenomenon, and perhaps, have not seen a detailed account of that grand spectacle, the following remarks of an eye witness may prove interesting.

The place from which we made our observations, was about 60 miles S. W. by W. from this city. The day had been very warm for the season of the year, and the atmosphere thick and smoky until sunset, after which, the thermometer fell very rapidly and the sky became perfectly clear. At about 9 P M, the shooting stars first arrested our attention, increasing both in number and brilliancy until 30 minutes past 2 A M, when one of the most splendid sights perhaps that mortal eyes have ever beheld, was opened to our astonished gaze.

From the last mentioned hour until day light the appearance of the heavens was awfully sublime. It would seem as if worlds upon worlds from the infinity of space were rushing like a whirlwind to our globe—then it would appear as if the firmament was slowly melting with heat, and the stars descending like a snow fall to the earth—until again some fiery sphere would start from its orbit blazing and hissing through the vast expanse, sweeping worlds from their places, and hurling whole systems from existence in its mad career.

These bodies seemed generally to shoot in lines from the zenith to every point of the horizon, crossing there however, sometimes at different angles from 5° to 45°, the greater number seeming to fall in a space of the horizon embraced by 15° north and south of north east. The light shown, was different by different meteors, and sometimes different by the same meteor. In some the ball or star gave out a pale blue or pale green light, while the streak or tail left would be orange or intensely white, and so on, exhibiting all the prismatic colors in instant changes; occasionally one would dart forward leaving a brilliant train three or four inches in width, which would gradually widen into a cloud three or four feet in apparent width, and remain visible, some of them nearly fifteen minutes. At other times some would appear and pass through an arc of 5° or 6°, when they would explode, and the new formed meteors possess all the features of the original one, passing very nearly in the same direction to different elevations from the horizon and become extinct.

But by far the most brilliant one which we saw occurred at a few minutes past five in the morning, and seemed to announce by its splendor the finale of this grand exhibition of fire works in the heavens. It seemed to pursue as near as we could judge a course from S. E. to N. W., the ball being apparently five or six inches in diameter with a train of from thirty to forty feet in length; the latter assuming immediately on the passage of the meteor a serpentine form, and diffusing a light upon the earth fully equal to that of the full moon, and remaining intense at least for forty or fifty seconds."

11. Phenomena as observed at *Bowling Green*, Missouri, Lat. 39° 20′ N., Lon. 91° W., as published in the Salt River Journal of Nov. 20th. (Communicated to Professor Silliman.)

"On Wednesday morning the 13th inst., from four o'clock until day light, a most sublime Phenomenon continued to present itself in the sky, and was beheld by most of our citizens. We were awakened, and told that the stars were falling, and flying in all directions of the heavens; and knowing that the individual who awakened us, was a person of observation and science, we instantly hurried from our room, for the purpose of witnessing a spectacle so extraordinary, and found what had been told to us, had the full appearance of being a reality.

This place, situated on an elevated point of an extensive prairie, presents an unbroken view of the horizon, and afforded an excellent opportunity of beholding this Phenomenon in all its various aspects, and impressive sublimity. The most perfect master of language would fail of conveying to others a full picture of this extraordinary and uncommon appearance, and vain would be his attempt to express the sensations of its beholders.

Above all, around the firmament—thicker than the stars themselves, which were uncommonly bright, large and beautiful—we beheld innumerable fire-balls of a whitish pallid color, rushing down, and to appearance across the sky—drawing after them, long luminous traces, which clothed the whole heaven in awful majesty, and gave to the air, and earth, a pale and death like appearance.

Our first look, after a common glance, was directly above to the zenith, and at that instant, an inconceivable number of meteors, or falling stars, as though the sky had just received a mighty shock, burst from the blue and cloudless arch, which never appeared more clear, and shot like so many burning arrows, towards every part of the horizon. We next turned our eyes to the west, and to appearance they were flying or floating with great rapidity in that direction; but we soon learned, to whatever point we turned, to that point, they seemed to direct their course.—This we think, affords sufficient evidence to induce the belief, that those luminous bodies were situated in the most elevated regions of the atmosphere—that they were directly descending, but in consequence of the density of the air, expired before they reached the earth.

They continued till near day light when they gradually disappeared, but we are informed that some were seen shortly after sunrise.

Though there was no moon, when we first beheld them, their brilliancy was so great, that we could, at times, read common sized print, without much difficulty, and the light which they afforded was much whiter than that of the moon, in the clearest and coldest night, when the ground is covered with snow. The air itself, the face of the earth, as far as we could behold it—all the surrounding objects, and the very countenances of men, wore the aspect, and hue of death, occasioned by the continued, pallid glare, of these countless meteors, which in all their grandeur, flamed "lawless through the sky." There was a grand, peculiar, and indescribable, gloom on all around —an awe inspiring sublimity on all above, while

———"the sanguine flood
Rolled a broad slaughter o'er the plains of Heaven,
And Nature's self did seem to totter on the brink of time!"

Forcibly were we reminded of that remarkable passage in Revelations, which speaks of the great red dragon, as drawing the third part of the stars of heaven, and casting them to the earth; and if it be a figurative expression, that figure appeared to be fully painted on the broad canopy of the sky,—spread over with sheets of light, and thick with streams of rolling fire. There was scarcely a space in the firmament which was not filled at every instant with these falling stars, nor on it, could you in general perceive any particular difference, in appearance; still at times they would shower down in groups—calling to mind the "fig tree, casting her untimely figs when shaken by a mighty wind," and their phosphorescent burning flashed around you like the mighty flash of lightning on the expanse of water, though more light and pallid.

The long luminous traces which they left behind, would last for several seconds; and at times, when the nucleus had entirely disappeared, those traces or streams, varying from ten to a hundred yards in length, would linger on the sky and continue to shine in all their brilliancy for two or three minutes, and then expire in a twinkling of an eye.

Their size was about the same as that of the morning star,—they moved something higher, and their velocity was much faster than that of the common meteors, and from the place of their starting to where they seemed to expire, it was, we would suppose, from ten to forty degrees.

You would now and then see some solitary ones, resembling balls of livid fire, like burning rockets shooting towards the earth, and emitting numerous sparks, as they boldly rushed into the more dense and vaporous atmosphere—acquiring as they fell, a more baleful and murderous aspect, and like incendiary spies, portending ruin and destruction.

We are also informed, that from the beginning of that Phenomenon, there was not a space in the firmament equal in extent to three diameters of the moon, which was not filled at every instant with falling stars; all of which left luminous traces from five to ten degrees in length, that lasted seven or eight seconds; and that many of them had a very distinct nucleus as large as the disk of Jupiter, from which darted sparks of vivid light. The light of those meteors was white, which is attributed to the absence of vapors, and the extreme transparency of the atmosphere; and we think, that those of a reddish and fiery aspect, which we beheld, had fallen from the rest, and that this appearance was the effect of the vapors which had risen from the earth, or of the thin clouds of smoke which had ascended from the burning prairies, into which they had wandered."

We have in our possession many other descriptions of similar merit with the foregoing, of which we shall make more or less use hereafter. These descriptions have been selected not merely on account of their supposed accuracy, but as affording accounts of the phenomena as they appeared in various parts of our country, from east to west and from north to south.

12. It was not until after the first sheets of this article were put to press, that the writer obtained the following ingenious observations made near this place, (New Haven,) by Mr. *James N. Palmer*, Practical Surveyor, &c.

Mr. Palmer, being abroad in the earlier parts of the night, and having observed an unusual number of falling stars, was induced to read over an account of the meteors described by Andrew Ellicott, which occurred Nov. 12, 1799. This being the same time of year, his curiosity was excited, and he mentioned to members of his family his expectation of a similar phenomenon. From 7 o'clock in the evening, he had noticed a reddish vapor, which first appeared low in the south, but gradually rose up the southern sky to the zenith. It was very thin, but still obscured the smaller stars. When this vapor appeared, the wind was southwest, although an hour or two before, it had been at the West. This vapor continued to prevail during the earlier parts of the meteoric display. Mr. P. retired to rest about 12 o'clock. At 2 o'clock, a man in his employment discovered the meteors through the window of his chamber, and immediately called him.

Mr. Palmer, considering the phenomenon as electrical, immediately made some experiments to ascertain the electrical state of the atmosphere. His silk pocket-handkerchief held at one end in the right hand and drawn swiftly through his left hand, emitted a very unusual number of electric sparks. On turning a small machine, he found the sparks which were usually short and feeble, much longer and more intense than he had ever seen them before. On presenting silk threads to an iron bar that stood on the ground leaning against the house, they were strongly attracted towards the iron.

He next examined his compass; found the needle more unsteady than ordinary, but on adjusting it to the meridian as nearly as he could, judged the declination of the needle to be the same as usual.

The meteors when first observed, were of a reddish color. Their number doubled within half an hour after his observations began, as he judged by comparing them with a given number of stars, which he took as his standard. They all apparently proceeded from a *circular space* S. E. from the zenith, and lighter than the adjacent parts of the heavens, which was small at first, but gradually enlarged its dimensions to the end of the observations, at which period it was many times larger than at first. Within this space he was unable to discover any meteors while standing erect, but by lying on his back he could discover numerous short lines of light, tardy in their motions, and confined chiefly to the northern periphery of the circular space. After 3 o'clock, Mr. P. ascended West Rock (an eminence situated near his dwelling) to the height of 200 feet. Nothing peculiar presented itself, except that the meteors appeared fewer in number there than at the previous level. He staid there fifteen minutes and then returned.

From three to four o'clock the air was still, but at 4 o'clock, a strong gust of wind blew for a short time from the north west, and immediately afterwards, the meteors increased astonishingly. This period, viz., four o'clock, may be considered as that of the maximum. These gusts returned at moderate intervals, with less and less force, each time occasioning a perceptible increase of meteors. The trains left by the exploding balls, were usually of a yellowish hue, but sometimes reddish. The streak was broadest in the middle. He heard at different times a number of slight explosions, which usually resembled the noise of a child's pop-gun, and was not unlike that of a fire-rocket. They were followed by a peculiar odor observed by all the company, (four men,) which one compared to the smell of sulphur, and another to that of onions. The meteors which afforded these sounds, all passed along in a north-west direction. Two of them had each a well defined nucleus, of the size of a tea cup. They severally afforded so much light that Mr. P. could distinguish the color of a man's beard. They passed below the tops of the trees at the distance of twenty five rods from the place where he stood, giving a "pop" just before they reached the trees.

One appeared to strike the barn, and gave a louder pop than any of the others. An *auroral* light resembling day-break, appeared constantly in the east from the time when his observations commenced.

Its altitude might be seven or eight degrees. A little before five o'clock, Mr. P. endeavored, with a theodolite, roughly to divide the great circle, which passed through the radiating point and the north and south points, into definite spaces. Of those meteors that marked their path on the sky, none descended below an altitude of 37°. Those which fell into the space rising 20° above this, were of a reddish hue, and had longer trains than any others. These trains subtend an angle of 40°, meteors of the same altitude having trains of uniform length. In the next space above (57°—77°) the meteors were of a paler hue, but more in number. In the third space of 25°, (77° N.—12° S.) which reached to the confines of the circular space above mentioned, the meteors were white, their trains short, and number greatest of all. These observations were made on the northern arc; no measurements were made on the southern side, but he judged the phenomena to be the same, except that the meteors were not so numerous as on the northern side.

From these and various other documents before us, we proceed to arrange and classify the principal facts so far as they are ascertained; and as these must form the basis of all correct reasonings on the nature and origin of the meteors, it is deemed advisable to make the collection very full, to state them, generally, in the language of the narrator, and to indicate the sources whence they are derived, not only as vouchers for their accuracy, but for the purpose of enabling readers who may desire it, to have recourse to the original statements.

II. Synopsis of the Facts.

1. Weather.—Throughout the entire region where the Meteors were observed, there was a sudden and extraordinary *change of weather from warm to cold,* accompanied by an uncommon transparency of the atmosphere.

(1.) *Boston.*—The thermometer yesterday at 2 P. M. was 63°; this morning at 4 o'clock, it was 39°. There was little wind, and this from the west. (Columbian Centinel.)

(2.) *Hartford, Con.*—The day preceding, it rained, and the air was very mild, the wind from the S. E. In the evening, the wind changed to the N. W. and it came off remarkably clear and cool, temperature 31°. (Independent Inquirer.)

(3.) *Philadelphia.*—The sky was clear, stars shining brilliantly, and wind high. (National Gazette.)

(4.) *Annapolis, Md.*—The heavens exhibited an aspect to gladden the heart of the astronomer. The winds were hushed; the whole firmament was absolutely cloudless; and all the starry host twinkled with a dazzling lustre. (Saml. B. Smith, M. D.)

(5.) *Salisbury, N. C.*—See Dr. A. Smith's observations, No. 9, p. 378.

(6.) *Charleston, S. C.*—The wind continued from N. E. during the day (Wednesday); the air was chilly and raw, the thermometer being depressed 15 or 16 degrees. (Charleston Courier.)

The temperature of the day before, had been oppressive, the mercury ranging as high as 78°. (Charleston Mercury.)

(7.) *Augusta, Geo.*—The day had been very warm for the season of the year, and the atmosphere thick and smoky until sun set, after which the thermometer fell rapidly, and the sky became perfectly clear. Heavy frosts ensued. (Georgia Courier.)

(8.) *Buffalo.*—The winds which had been very heavy for many hours, had abated considerably, every vestige of clouds had disappeared, and the stars were shining through an unusually clear atmosphere. (Buffalo Journal.)

(9.) *Poland, Trumbull Co. Ohio.*—The day previous was mild, damp, and cloudy. At the approach of evening the weather became clear, and so cold that before morning, the mud in the streets froze sufficiently hard to bear the weight of a man. (Dr. Jared P. Kirtland's letter to Prof. Silliman.)

The only exception we have met with to the fact under review, occured in the northern parts of New England in the direction of Montreal, where the sky was said to be overcast.

(10.) A gentleman who was riding in the stage in St. Lawrence Co. informs us, that, instead of a shower of meteors, he encountered a fall of snow. He however noticed frequent flashes of bright light, and the stage driver remarked that it was strange that there should be lightning during a snow storm. (New York Daily Advertiser, Nov. 26.)

2. Time and Duration.—The meteors began to attract notice by their unusual frequency or brilliancy, from *nine to twelve o'clock* in the evening, were most striking in their appearance, from *two to five*, arrived at their maximum, in many places, about *four* o'clock, and continued till rendered invisible by the light of day.

(1.) *Long Island Sound*, Lon. 72°.—We are informed by a gentlemen who was at the time on board a steam boat in Long Island Sound, that he first observed the meteoric bodies at 11 o'clock in the evening, and continued to watch them till sunrise. (Brattleboro', Ver. Independent Inquirer.)

The pilot of the Steam Boat Providence, then on her way from New York to Providence, watched this extraordinary spectacle from its commencement, about 3 o'clock in the morning, till it disappeared in the approaching light of the sun. (Professor Caswell.)

(2.) *Hartford, Con.* Lon. 72° 50′.—First noticed about 12 o'clock, but was most brilliant between 3 and 4. (Independent Inquirer.)

(3.) *New Haven, Con.* Lon. 72° 58′.—Observed as more frequent than usual as early as 11 o'clock, and became striking as early as 3 o'clock, and arrived at the maximum about 4 o'clock.

(4.) *New York City*, Lon. 74° 1′.—Commenced immediately after midnight. Then the star shoots were few and far between. By 1 o'clock, the discharge had become almost incessant; and by 2 o'clock, the whole heavens were streaked with liquid fire. (Old Countryman.)

The watchman said it was thickest about 4 o'clock. (Journal of Commerce.)

(5.) *Annapolis, Md.* Lon. 76° 43′.—They began as early as 2 o'clock, and increased in number and brilliancy, till about 4, when they prevailed for more than an hour, almost without cessation. (President Humphreys.)

(6.) *Washington City*, Lon. 77° 2′.—This morning, about half past 4 o'clock, our attention was arrested by something which appeared like what is called a falling star; pretty soon another, and another appeared; their number increased gradually until, upon going out into the open air, they presented one of the most extraordinary and sublime spectacles that we have ever witnessed. (Washington Telegraph.)

(7.) *Richmond, Virg.* Lon. 77° 27′.—These shooting stars were first observed about a quarter before 1 at night, as we are informed by the centinels of the state guard who were on post during the night. (Richmond Compiler.)

(8.) *Niagara Falls*, Lon. 78°, 50′.—Seen as early as 2 o'clock, and soon after came to their maximum. (Mr. H. A. Parsons to Professor Silliman.)

(9.) *Salisbury, N. C.* Lon. 80° 10′—A few meteors of inferior brightness, in remote regions of the atmosphere, were seen by me before midnight: some as early, I feel pretty confident, as 10 o'clock. After midnight they rapidly increased in number and brilliancy till 4 o'clock. The display was then in the highest degree magnificent. (See Dr. A. Smith's letter, No. 9. p. 378.)

(10.) *Charleston, S.C.* Lon. 81°.—We learn that a gentleman who was off the bar, mentions that at sea, the starry shower commenced as early as 9 o'clock, and continued till sunrise. (Charleston Mercury.)

About 10 o'clock, shooting stars were observed to succeed each other with unusual frequency; but at about 3 o'clock in the morning, the wind, which had been from the west, having changed and blowing with freshness from the N. E., there was a burst of splendor throughout the firmament. (*Ib.*)

(11.) *Poland, Trumbull Co. Ohio.*—First began to be visible in considerable numbers as early as early as 12 o'clock, maximum from 2 to 3. (Dr. J. P. Kirtland to Professor Silliman.)

(12.) *Georgia*, (60 miles S. W. by W. of Augusta) Lon. 82°.—At about 9 o'clock, the shooting stars first arrested our attention, increasing both in number and brilliancy until 30 minutes past 2, when one of the most splendid sights perhaps that mortal eyes ever beheld, was opened to our astonished gaze. (Georgia Courier.)

(13.) *Macon, Geo.* Lon. 84°.—From 11 until 2 o'clock, an unusual number of meteors were seen shooting in the sky. About that time, the splendor of the phenomenon commenced, and continued to increase until 5 o'clock, and faded only with the light of day. (Georgia Messenger.)

(14.) *Natchez, Miss.* Lon. 91° 24′.—From midnight until daylight, the whole heavens were brightly illuminated by the glare of thousands of meteors shooting in every direction. (Natchez Courier.)

(15.) *Cantonment Jesup. La.* Lon. 93° 30′.—From 2 o'clock to sun rise. (Dr. M. C. Leavenworth.)

(16.) *St. George's Bank.*—A gentleman who came passenger in the Hilah from Liverpool, states that on the night of the 12—13, she was on St. George's Bank, about three hundred miles distant from the coast. The meteoric phenomenon was as splendid there, as it is described to have been here, and occurred at the same time of the night. (N. Y. Daily Advertiser, Nov. 26.)

(17.) *Union Town*, Penn. Lon. 79° 20′.—The writer witnessed the phenomenon under very favorable circumstances, and observed it with great attention from about half past 4 o'clock, until sunrise. When first observed but few meteors were visible, but their number and brilliancy rapidly increased for half an hour, from which time the whole visible heavens, from the zenith to the horizon, was streaming with them. (J. B. M. Union Town Democrat, Dec. 4.)

Remarks.—The longitude of the several places of observation, is given, to enable the reader to judge how far difference of longitude will account for the time of commencement, or of arriving at the maximum. We postpone any comments for the present.

Want of definiteness in some of the observations, renders it difficult to determine the time when the phenomenon commenced, and when it arrived at its greatest height. As "falling stars" are no unusual occurrence, the attention of the spectator would not be particularly arrested, until the number and brilliancy became much greater than common.

In some cases, the number of meteors falling within a given time appears to have been affected by the wind. See No. 10. and p. 384.

It is manifest also, that the observations of those who were out all night as in Nos. (1.) (7.) (9.) (14.) are to be particularly valued.

3. Number.—The whole number of meteors that fell towards the earth cannot be accurately estimated, but it must have been *immensely great.* Few accurate attempts appear to have been made to estimate the number of meteors that fell within a given time. It is well known that the number of the stars is, by most people, greatly overrated ; and, for a similar reason, the number of the meteors was doubtless generally estimated much too high, some describing them as descending by " thousands" at a time, and some even by " millions."

The writer in the Boston Centinel, whose description we have inserted at length on page 366, appears to have made as exact an estimate as any we have met with, although we think it considerably too low. He supposes the number of meteors which fell during the fifteen minutes before 6 o'clock to have been 8660. Consequently they must have fallen at the rate of 34,640 an hour, making for three hours, 103,920. The observer mentions that the number had become fewer at the time of counting, in consequence, probably of the advancing light of day. Reckoning, therefore, from 12, till 7 o'clock, we may safely double the foregoing amount, making the aggregate number of meteors 207,840,—an estimate which probably does not exceed, though it may fall very far short of the whole number which were visible at Boston. On the supposition that the meteors seen at places remote from each other, were not the same, the entire number that descended towards the earth, must have been indefinitely great.

The meteors however, were not uniformly distributed over the sky, but appear, at some places of observation, to have been peculiarly abundant in particular parts of the heavens.

(1.) The phenomenon was most brilliant to the south and west of Lynchburg, at an elevation of from 30° to 60°. (F. G. Smith.)

(2.) The greatest number seemed to fall in a space of the horizon north and south (east?) of north east. (Geo. Courier.)

(3.) Mr. Palmer, found the number of meteors north of the apparent radiating point much greater than on the south side. See p. 385.

4. Varieties.—The meteors exhibited three distinct varieties : the first consisting of *phosphoric lines*, apparently described by a point; the second, of large *fire balls*, that at intervals, darted along the sky, leaving trains that occasionally remained for some time ; the third, of *luminous bodies that continued for a long time in view.*

(1.) At *Annapolis*, these meteors had two distinct appearances: one was a dull, red colored line, similar to iron visibly heated, the other that of the splendid radiance of a star, or of a rocket just exploded. (Dr. S. B. Smith.)

(2.) See, among the general description, No. 5.

(3.) The *first* of these varieties is recognized in many descriptions by comparing the appearance to that of large flakes of snow, in the expressions "it snowed fire," &c. "I found the entire atmosphere [at 4 o'clock] filled with flakes of fire; I say *flakes*, for they resembled flakes of snow of a stellated or radiated form, apparently an inch in diameter, of a pale rose red, falling in a vertical direction as thickly at the moment as ever I saw snow, there being no wind to deflect them from the perpendicular; and when within ten or twelve feet of the earth, bursting (I could not detect either explosion snapping, or cracking) into innumerable spangles, or smaller stars, precisely as a rocket does." (Rush M'Connel, M. D., at Mauch Chunk.) On this comparison a writer of Union Town, Pennsylvania, remarks: "The phenomenon did not in the least resemble a shower of snow, to which it has been compared, either in the number, direction, or velocity, of the objects presented to the vision. The meteors did not *fall* towards the earth, but shot off like streams of fire at an angle of less than thirty degrees with the horizon,—not slowly like falling flakes of snow, but with nearly the rapidity of lightning, often crossing half the visible heavens in less than a second." (J. B. M. Union Town Democrat.)

(4.) Of the *second* variety, we have descriptions in almost every account of the phenomena. We subjoin a few of these notices. See, among the general descriptions, No. 1.

At *New York.*—At about quarter past 5 o'clock, we saw a star shoot from the zenith, about two or three points westward of north, which in its descent, showed a line of fire, the color of fish blood, about two or three inches wide, which, after traversing far down the vault, formed a ball of the size of a man's hat, and then rushed on the road it had come, and actually assumed the form of a serpent. It lay upon the firmament, we say ten minutes, others say twelve, and then it struck off it seems to the west, and rolled up its coils. (Old Countryman.)

At *Richmond*, *Virginia.*—Two were observed of the size of a six inch globe, the one ten minutes later than the other. The course of the first was N. E. leaving behind a train of light two or three hundred yards in length, while sparks were flying from the body of the meteor in every direction, until it burst into a thousand particles. This, from its first appearance, till it burst, continued in view until the number *sixty three*, was distinctly counted. The course of the latter was S. E. and it was visible while the number *one hundred and thirty seven* was counted. (Richmond Enquirer.)

At *Macon, Geo.*—One of considerable size was observed to fall it was believed as near to the earth as one hundred feet, when it entered a column of smoke from a chimney, and immediately exploded into several parts. (Georgia Messenger.)

At *Niagara Falls.*—In many instances, the meteors appeared like large balls of fire, and some were as large as an eighteen pound cannon ball. (Mr. H. A. Parsons.)

At *Union Town, Penn.*—Not more than two of the meteors observed by me left behind them *vapory* matter: one of these proceeded towards the north, the other towards the northwest. The vapor did not differ in appearance from the light fleecy clouds frequently visible in the heavens, and it gradually melted away being borne along in the meanwhile towards the east, in which direction there was a gentle movement of the air. (J. B. M. Union Town Democrat.) See descriptions.

(5.) Of the *third* variety, the following are remarkable examples.

At *Poland, Trumbull County, Ohio.*—A luminous body was distinctly visible in the north east, for more than an hour. The Hon. Calvin Pease informs me that he discovered it at 4 o'clock, near the star Alioth, in Ursa Major; that it was then very brilliant in the form of a *pruning hook*, and apparently twenty feet long and eighteen inches broad, and that it gradually settled towards the horizon, until it disappeared. I first saw it at 5 o'clock, when it resembled a *new moon*, two or three hours high, shining through a cloud, about fifteen minutes afterwards, no vestige of it could be seen. (Dr. Jared P. Kirtland's letter to Prof. Silliman.)

At *Niagara Falls.*—They were seen as early as two o'clock, and soon after, a large luminous body, like a *square table*, was seen nearly in the zenith, remaining for a time nearly stationary; and from this were emitted large streams of light. (Mr. Horatio A. Parsons's letter to Prof. Silliman.)

Off *Charleston, S. C.*—We learn also that a meteor of extraordinary size, was observed at sea to course the heavens for a great length of time, and then explode with the noise of a cannon. (Charleston Courier.)

Remarks.—The following points appear deserving of particular notice.

That according to Mr. Palmer, (See p. 385.) the balls which in their descent, terminated at nearly the same altitude, had trains of nearly the same length; that the number increased, but the trains became shorter at higher altitudes; and that the light was reddish at the lower altitudes, and pale or white at the higher.

That the trains presented to different spectators, at first, the figure of two very acute cones placed base to base; but their figure afterwards became tortuous, and they finally resolved themselves into small clouds or nebulæ, which took the direction of the wind.

5. Height.—The appearance of the meteors was such, as to give to spectators the impression, that they were generally low in the atmosphere, and that they sometimes descended quite to the earth.

(1.) Generally the meteors appeared to be very low in the atmosphere: some, to come down apparently almost to the house tops. ("Observer," Boston Centinel.)

(2.) Their general height above the earth was apparently not more than two or three miles, and they frequently appeared to fall within a few hundred yards of it before they became extinct. (Georgia Messenger.)

(3.) See Mr. Palmer's observations, p. 383.

(4.) They appeared to be extinguished in an azure belt, that encircled the horizon. (Richmond, Virg. Enquirer.)

(5.) Many of the meteors seemed almost to strike the masts of the vessels. (Charleston Mercury.)

(6.) Some expired soon after the commencement of their motion; others descended apparently quite down to the water's edge, leaving behind them a bright luminous track. While descending, it seemed as if some would fall upon the deck of the boat though none did. (Pilot of the Steam Boat Providence, as stated by Professor Caswell.)

(7.) They ceased to appear when within 10 degrees of the horizon. (New York Commercial Advertiser.)

(8.) They appeared to form high in the air, and to become extinct within 50 or 100 feet of the earth. (Dr. J. P. Kirtland of Poland, O.)

6. Sound.—According to the observations of by far the greater number of spectators, the meteors were unaccompanied by any peculiar sound; but on the other hand, such a sound, supposed to proceed from the meteors, was distinctly heard by a few observers in various places.

(1.) None was heard by the writer of this article, though listened for with much attention. Mr. Daniel Tomlinson of Brookfield, Con. informed the writer, that he listened repeatedly to discover if there was any report, but could hear none. Yet Mr. Palmer heard sounds resembling a pop-gun, or the smaller explosions of a sky rocket.

(2.) Dr. Lee, of New Britain, a few miles northeast of New Haven, saw the meteor which is described p. 366, as falling near Capella, and thinks it was accompanied by a noise like the rushing of a skyrocket. (Letter to Prof. Silliman.)

(3.) No sound was heard at Providence, nor by the pilot of the steam boat in Long Island Sound; a *hissing noise* is said by others to have been heard after this explosion. (Professor Caswell.)

(3.) One in the northeast, was heard to explode with a sound like that of a rush of a distant sky rocket. The time from the explosion to the hearing, was about 20 seconds. (N. York Commercial Advertiser.)

(4.) At 4 o'clock, it appears that the explosion of one of the falling balls was sensibly heard. (New York Old Countryman.)

(5.) President Humphreys heard no sound at Annapolis, Md. (See p. 372.)

(6.) Dr. Smith, at Salisbury, N. C., heard no sound in the case of a meteor larger than the full moon, "though every sense seemed to be suddenly aroused, in sympathy with the violent impression on the sight." Nor did he at any time hear any aerial noises. (p. 379.)

(7.) I could distinguish no report even from the largest of these bodies. (Mr. V. H. Barber, Frederic, Md.)

(8.) A crackling sound attended them both. (Richmond Enquirer.)

(9.) Loud explosion said to have been heard off Charleston. (See p. 391.)

Remarks.—It is well known that persons unaccustomed to observations in the stillness of night, are apt when listening, at such times, to hear sounds which they associate with any remarkable phenomenon that happens to be present, although wholly unconnected with it. This fact suggests the necessity of caution in the present case.

Meteors which were distinguished for their brightness and apparent magnitude, and which would therefore be expected to afford sounds, might still be too distant for such sounds to be audible; or might be in a region of the atmosphere where the air is too much rarefied for the purposes of sound. It is possible that fragments of such large meteors might reach the ground, and give a slight report, while the explosion of the great body of the meteor was unheard. (See Mr. Palmer's observations, p. 384.)

The question whether any sounds proceeded from the meteors, must rest, for its decision, on the circumstances of the case; such as the peculiarity of the sounds, their nature as described by different observers, &c.

7. Course and direction.—The meteors moved either in right lines, or in such apparent curves as, upon optical principles, can be resolved into right lines. To some observers, they appeared to descend directly downwards; to others to tend towards the northwest; and to others, to move in every direction.

(1.) Their course was directly downwards, and not oblique as is usually seen, except in two instances, when the course was horizontal, nearly in a straight line, from N. E. to S. W., and these two meteors were high and small. ('Observer,' Boston Centinel.)

(2.) See Mr. Palmer's observations, p. 384.

(3.) The line of descent was rectilinear, the course from the direction of the zenith towards the horizon, and most generally in a line varying from 10° to 45° from a vertical line. Many fell directly downwards towards the earth. (Philadelphia National Gazette.)

(4.) All tended westward. (Dr. S. B. Smith, Annapolis Republican.)

(5.) The greater number inclined in a path towards the west and north, in an angle of 60° with the zenith, [with a vertical line?] while some few seemed almost perpendicular, and others, nearly parallel with the surface of the earth. (At Halifax, Vir. Richmond Enquirer.)

(6.) Their direction was a little to the west of a perpendicular line, when you look north or south. (Augusta, Geo. Courier.)

(7.) They fell in every direction resembling a fall of snow. (Geo. Messenger at Macon.)

(8.) At Concord, N. H. the course of many of the meteors was observed *from the horizon towards the zenith,* and in every other direction. (Professor Caswell.)

(9.) They all passed, while visible, with great velocity through the air, but in no uniform direction; some *rose,* some fell, others moved horizontally, and others again at every conceivable angle to those several courses. (Buffalo Journal.)

(10.) At Poland, (Ohio,) these fell uniformly from S. E. to N. W., forming an acute angle with a vertical line. (Dr. J. P. Kirtland.)

(11.) At Matanzas, (Cuba,) they descended in perpendicular lines, describing arcs from the zenith to the horizon. (Mr. A. Mallory to Professor Silliman.)

8. Apparent origin.—The meteors, as seen by most observers, appeared to proceed from a fixed point in the heavens, which some referred to the zenith, and others to a point a little S. E. of the zenith. Those who marked its position among the fixed stars, observed it to be in the constellation Leo, in which it appeared stationary, accompanying that constellation in its diurnal progress.

(1.) From a point in the heavens, about 15° S. E. from our zenith, the meteors darted to the horizon in every part of the compass. (New York Commercial Advertiser.)

(2.) They appeared in every direction, but chiefly shooting from the zenith to the east and south. (Great Falls, N. H. paper.)

(3.) They went off in radii from one center in all directions, but more frequently, and in greater numbers to the S. E. and N. E. (Hartford Independent Press.)

(4.) They all appeared to shoot from one and the same center towards the circumference of a circle. This center was in the cluster of stars called the *sickle*, about the middle of its bend, and about 6° or 7° northwesterly of the star Regulus. (F. L., Union Town, Penn. Democrat.)

(5.) According to my observation the radiant point was directly in the zenith. (Mr. James Sperry, Henrietta, N. Y.)

(6.) The central part seemed to stand nearly over our village, from whence, (some further off,) issued thousands of small meteors similar to stars, descending in all directions towards the horizon. (Wooster, Ohio, Telegraph.)

(7.) Capt. Parker, of the ship Junior, then in the Gulf of Mexico, saw a radiant point in the *north east*, from which the motions of all the meteors were directed. (Mr. Alex. C. Twining.)

(8.) See among the general descriptions, Nos. 1. 3. 4. 5. 6. 8. 10.

Remarks.—This apparent radiation from a common center, is mentioned much more uniformly in places northward of the City of Washington, than in places southward of that city, where the meteors are generally represented as flying in all parts of the heavens; yet the same fact is recognized in the accounts from Augusta and Macon, in the state of Georgia, and from Kingston, Jamaica, at which places the meteors are said to proceed from the zenith. Dr. Smith, (see p. 379.) thinks it could not have been true of the phenomenon as exhibited in the western part of N. Carolina; and had it been as conspicuous there as here, or had it even been discoverable there at all, it is difficult to see how it could have escaped so acute an observer. On the northern limits also, to which our information has extended, as at Concord, N. H. and Buffalo, N. Y., the regularity of descent from a common center seems to have been interrupted, since at these places some of the meteors rose, while others fell, and others moved in all directions.

Those who are unaccustomed to astronomical observations, are apt to assign a wrong position to the zenith from the difficulty of looking directly upwards. The error frequently amounts to ten or fifteen degrees, a fact which will account for discrepancies in the statements of different observers of the radiant point in question, one placing it at the zenith, and another fifteen degrees southeasterly from it, where the time and place of observation were nearly the same.

(3.) The testimony showing that the radiant point was *stationary* among the stars will be considered hereafter.

9. Matter supposed to come from the meteors.—In several instances, material substances were supposed by the observers to fall upon the earth; and in a number of cases, matter was found which was supposed to have proceeded from the meteors.

(1.) We have received a communication from Mr. H. H. Garland, of Nelson Co., who states, that on hearing a large drop of water fall on the roof of a coop, he immediately looked, and discovered a substance of about the circumference of a twenty five cent piece, of the consistence and appearance of the white of an egg made hot, or perhaps, animal jelly broken into fragments would be a better comparison. (Richmond Enquirer.)

(2.) Persons in this town saw particles of "fiery rain" strike the ground, and on examination, discovered *lumps of jelly*, as they term them. (Rahway, New Jersey Advocate.)

(3.) After sun-rise, a mass of gelatinous matter was found, which, from its singular texture, is supposed to have formed one of the large meteors. Its appearance resembled soft soap. It possessed little elasticity, and on the application of heat, evaporated as readily as water. The manner in which this substance fell on the ground, indicated that it had fallen with prodigious force. (Newark, N. J. paper.)

(4.) A woman at this place (West Point,) who was milking about sun rise, on the 13th, saw something come down "with a sposh" before her. On looking she saw a round flattened mass, about a tea cup or coffee cup full, looking like boiled starch, so clear that she could see the ground through it. At 10 o'clock, she went out to show it to some persons, and no vestige of it remained. A boy observed some minute white particles on the spot, as large as small shot, or pin's heads, of irregular shape, and falling to powder, and disappearing when he went to take them up. I went to the spot with the woman and boy, and concluded that if I heard of any analogous facts from other quarters, I would consider this as entitled to notice, but not otherwise. (Mr. Alexander C. Twining to Prof. Olmsted.)

(5.) One of our citizens was awakened by a ball of fire falling against his window. (Hartford Times.)

10. Electrical and magnetic observations.—Observations made in various places, indicated a highly electrical state of the atmosphere. No very decisive observations with magnetic instruments, have come to our knowledge.

(1.) See Mr. Palmer's experiments, p. 384.

(2.) Dr. Kirtland, at Poland, Ohio, "on retiring to rest, a little after 10 o'clock, discovered brilliant electrical sparks emitted from his clothes on any slight motion." (Letter to Professor Silliman.)

(3.) While riding in the town of Fredonia, (says a correspondent of the New York Daily Advertiser,) in the evening of the 14th inst. between 6 and 7 o'clock, the night after the meteoric display, the tips of the ears of my horse, for a half an inch in length, became luminous, and similar in appearance to phosphorescent bodies. It remained for some minutes.

(4.) No change was noticeable in the magnetic dip, variation or intensity. Gold leaf electrometers were excited by a touch. The pendulum of De Luc's dry pile was accelerated. (Mr. F. G. Smith, Lynchburg, see p. 376.)

Remark.—It is very much to be regretted, that so few magnetic observations were made. The writer of this article suggested to several of his scientific friends soon after the occurrence, the probability, (from the known effect of auroral appearances on the needle,) that the declination of the needle might have been greatly altered during the phenomenon, a remark to which he is inclined to attach the more importance, from the following passage in a letter from Dr. Aiken of Emmittsburg. "Owing to an accident (says Dr. A.,) I cannot furnish you with any precise data in reference to the magnetic needle. I have, however, every reason to believe, but advance it simply as an opinion, that the declination of the needle at this place, was much greater during the continuance of the meteoric shower, than before or since."

11. Auroral appearances.—Phenomena resembling more or less the Aurora Borealis, were visible in some places, although in many other places no appearances of the kind were observed.

(1.) A bank of auroral light, resembling day-break, was observed at New Haven, by Mr. Palmer the greater part of the night. See page 384.

(2.) There was a vapor in the atmosphere, visible round the horizon, which, in the southeast, assumed a very beautiful appearance half an hour before sun rise. (Observer, Boston Centinel.)

(3.) There were no auroral appearances observed at Halifax, Vir. (Richmond Enquirer,) nor at Providence, (Professor Caswell,) nor at Lynchburg, (F. G. Smith,) nor at Salisbury N. C. (Dr. A. Smith.)

(4.) At Dover, (N. H.) there was an appearance of the Aurora Borealis, early in the preceding evening, which continued till 4 o'clock in the morning, when it suddenly broke out into streams of strong light, spreading into columns, changing into a thousand different shapes, varying their colors through all the tints of the rainbow, and shooting from the horizon almost to the zenith. This scene was followed by a splendid exhibition of fire works. Luminous balls might be seen darting about with great velocity, leaving behind them a train resembling that of a comet. The whole was closed by the formation of a triumphal arch which vanished before the coming light of morning. (Professor Caswell.)

(4.) The aurora borealis during the whole time of my observations, which was about half an hour, [from half past 4 to 5 o'clock] was distinctly visible, though by no means so brilliant or so active, as that meteor usually is when visible here. (Buffalo Journal.)

(5.) There was also [at Cincinnati,] an aurora or boreal light in a direction a little north of east. The lower edge of this bank of light appeared to be several degrees above the horizon. (Letter of Mr. Darius Lapham to Professor Silliman.)

(6.) At Poland, Ohio, at 10 o'clock in the evening, the aurora borealis was very distinct. (Dr. J. P. Kirtland.)

12. Concurrent phenomena.—Near the time of the meteors, there were several remarkable events, which it may be well to record, although they may not have the least connexion with the phenomenon under review.

(1.) Woodburn, near Hudson, Nov. 15.

A singular occurrence took place on my farm some days ago, which has excited a good deal of speculation among all who have visited the spot. A wood containing about an acre and a half, suddenly sunk down about thirty feet, most part of it perpendicularly; so that, where not long since the trees were to all appearance firmly imbedded, the topmost branches now peep out. (Quoted in the New York Evening Post.)

(2.) Soon after 10 o'clock, I felt a slight repetition of the tremulous motion of the earth, which has repeatedly been observed in this vicinity of late. (W. F. G. Smith, Lynchburg, see p. 376.)

(3.) At Harvard, in this state, at about 8 o'clock on the morning of the 13th [Nov.] there was a slight shower of rain, when not a cloud was to be seen, the weather being what is called perfectly fair. (Boston Mer. Journal.)

(4.) The writer of this article observed an appearance resembling zodiacal light, between the hours of 7 and 8 on the evenings of Dec. 1st and 3d. That of Dec. 3d. was observed by Messrs. Forrest Shepard, and J. N. Palmer, of New Haven. It consisted of an auroral appearance in the west following the twilight, being an apparent prolongation of the latter. It reached to a length of about 25°, towards the head of Aquarius. We imagined the galaxy, in that part of the heavens, appeared more luminous than usual.

After the foregoing synopsis of facts was prepared, and partly printed, the writer received a letter from his valued friend and correspondent, Mr. A. C. Twining, dated Dec. 16, communicating the result of his inquiries among the vessels of New York harbor which had arrived from distant places, since the 13th of November. The results of this investigation are too valuable to be omitted, and we accordingly subjoin as many of them as our limits will permit.

" Since my last, I have visited New York, and from my inquiries on board of fifteen ships, I glean a few facts worthy of record.

Five ships on the Atlantic, between latitudes 40° N. and 50° N. and longitudes 30° W. and 50° W. experienced powerful gales and heavy weather, on the 13th of November, and some days preceding, and following. One, about lat. 45° N. and 40° W, experienced on the 11th from W. N. W. a gale of terrible violence. Not one ship could be found on the European passage homeward, that saw any thing of the phenomenon on the morning of the 13th, within the limit named. This was probably the result of cloudy and windy weather obscuring the heavens.

The ship *St. George* from Liverpool, in lat 51½° N. Lon. 20° W. with clear skies on the morning of the 13th, at a time corresponding to that of the appearance of the meteors in this country, was not in sight of the phenomenon; at least it was not noticed by either watch nor by any one on board. Wind the preceding day squally from the west; on the 13th at 5 A. M., calm; at 6 41° W. had clear skies but no meteors were seen.

The ship *Douglas*, from Rio Janeiro, in Lat. 2° N. Lon. 41° W., had clear skies, but no meteors were seen.

The brig *Francia*, from Amsterdam, in Lat. 36° N. Lon. 61° W., experienced on the morning of the 13th, winds from the W. S. W. and N. W., blowing a severe gale. The skies being clear; the mate saw towards the morning an unusual number of meteors or falling stars. From the mate's account, it is certain that they were comparatively few in number—not more perhaps than four or five in a minute—at all events, a number that might easily have been counted.

The ship *Junior*, Capt. Gideon Parker, from Mobile for New York, was in the Gulf of Mexico, Lat. 26° N., Lon. 85⅓ W. Capt. Parker being on deck a little before three o'clock, on the morning of Nov. 13th, noticed several meteors, but not more than he had often seen before. Heavy dark clouds hung low in the N. E., from which the second mate (who held the watch before Capt. P. came on deck) said that the first meteors he saw seemed to break like lightning. Above the clouds, which were from 15° to 25° high, the sky was clear, and the stars bright as usual. About three o'clock, Capt. P. first noticed the unusual number of falling stars, and began to count their number, but was forced to desist, by their rapid increase. For an hour and a half, Capt. P. observed them. During that time they were seen only in the north-east, above the cloud, and the eye at first would take in nearly the whole space of their action, which extended 6 or 7 points along the horizon, and about 45° in altitude above it; but towards the latter part of its obscuration, the space was more extended, say 12 or 14 points horizontally, and a few degrees higher in altitude. During its whole period of obscuration, *not one was seen in the west*; although Capt. P. looked particularly to this fact, and called the mate's attention to it at the time. Capt. Parker distinctly remembers a radiant point in the N. E., from which all the courses were directed, some shooting horizontally, some vertically, and others at all inclinations between the two, but none upwards,—some shot towards the north, and some towards the east. This radiant at first held about 45° of altitude, but seemed to rise 5° or 10° in the period of his observation; without, however, moving from the N. E. at all. The meteors resembled common shooting stars, and were mostly as minute in magnitude as the stars themselves,—ten or twelve, however, would compare in size with the morning star. Some of the larger moved over a space of 15° to 20°, and some of them seemed to develope themselves not far from the point, and to go behind the cloud. All that descended low enough, passed behind the cloud,—not one between the cloud and the observer. Near to the radiant, the courses of some that were observed were very short—not more than 2° or 3°. All, both large and small, left a luminous trace, in which no prismatic colors were observed; and no one of the traces was observed to continue visible more than two seconds. The afternoon of the preceding day had been squally, and wind variable; but at the time of observation there was light wind from N. E.

At nearly half past four, Capt. Parker yielded the deck to his mate, who states that soon after he came on deck, the stars appeared passing over from the N. E. into the west. In the west their courses were very short, and they seemed "just to let go their hold." The ship was heading S. E. He continued on deck till eight o'clock, A. M. In the mean time, the meteors increased in number, and spread over the whole heavens, and were most brilliant about six o'clock. The sun rose at half-past six.

The ship *Tennessee*, Lat. $23\frac{1}{2}°$ N., Lon. 82° W., was in view of the meteors on every side, from 4 to 6 o'clock, A. M. They seemed to follow the direction of the wind, which was E. N. E.

Of all the observations, Capt. Parker's are the most definite and accurate. It follows as one consequence from them, that the radiant lay more to the north to his view than to ours; for at 3 o'clock, to him the Lion's neck lay E. 5° N. and 45° high, while he observed the radiant at E. 45° N. and 45° high. With his observation, agrees pretty well the general observation made by the mate of the Tennessee."

Review of the foregoing Facts.

1. The *change of weather* which took place about the time the meteors appeared, was very remarkable both for its amount and for the extent of country which it pervaded. Some additional facts have come to our knowledge since those mentioned on page 385, were put to press, which give much interest to this head. Such are the following.

The change of temperature at *Mobile*, Alabama, (Lat. 30° 40′, Lon. 88° 11′,) is thus described in a communication from *Alexander Jones*, M. D. addressed to Professor Silliman.

"For several days before, the weather had been unusually warm for the season, the wind prevailing from the S. S. W. On the 11th, a shower of rain fell; on the 12th, the wind changed to N. W. The thermometer, for several days previous to the night or morning of the 13th, stood as high as 80° F. On that night it fell down to about 40°. For two weeks afterwards, we had the severest spell of continued cold weather ever experienced in Mobile, at the same season of the year."

The reduction of temperature extended as far westward as *Natchitoches* in Louisiana, (Lat. 32°, Lon. 93°,) as we learn from *Dr. Leavenworth* of the U. S. Army, who is stationed near that place. He says "the night, although not cold, was much cooler than the preceding ones had been."

It appears however by a communication from *Mr. A. Mallory* addressed to Professor Silliman, that the change of weather was hardly perceptible at *Matanzas* in the Island of Cuba, although the meteoric appearances were much the same there as here. Mr. Mallory observes that "there was nothing singular in the appearance of the atmosphere either before or after the 13th, the thermometer ranging from 77° to 84° on the 12th, and from 75° to 82° on the 13th, with a pleasant sea breeze and a clear sky. The barometer at sun rise stood at 29.90."

But for the most remarkable statements on this head, we are indebted to *Mr. Twining*, (see p. 399.) It appears that about the time under review, there was, in a certain part of the Atlantic Ocean, between the latitudes of 40° and 50° N., and the longitudes of 30° and 50° W., a *violent gale of wind.* The conclusion of Mr. Twining, that the reason why no meteors were seen eastward of the fiftieth degree of west longitude, was because the sky was obscured, is strengthened by the fact, that a little westward of this limit, the appearance, as observed by the ship Hilah, on St. George's Bank, is represented to have been as splendid as at New York. Off Bermuda, likewise, the ship Phoenix, of New London, (as we learn from Messrs. Billings's, the owners,) witnessed such a display as would correspond to the appearance at New Haven.—Accounts received from London, dated as early as the 13th of November, make no mention of the meteors; whence we infer that they were not seen there, and probably not in any part of Europe.

It is hardly possible to persuade ourselves that two concurrent phenomena, both so remarkable as the change of weather and the falling stars, were independent of each other; but it may prove a difficult point to decide what was the nature of this connexion; whether, as some have hinted in observations already before the public, the meteors were occasioned by the change of weather, in consequence of the highly electrical state of the atmosphere which frequently follows such a change; or whether higher portions of the atmosphere descended bringing the meteors along with them; or whether the meteors themselves, by disturbing the equilibrium of the atmosphere, caused air from colder regions to flow into the parts where they prevailed; or, finally, whether some common and remote cause is to be sought for, that gave origin to both the change of weather and the meteors.

2. There is much indefiniteness in most of the accounts we have seen, respecting the *time* when the phenomenon commenced. As "shooting stars" are not uncommon in a clear evening, they would not attract particular attention until their number became much greater than usual. All accounts agree that the phenomenon advanced very gradually, but the time when the meteors first arrested attention by their uncommon frequency, is variously noted. In places differing many degrees of longitude from each other, as New Haven, (Con.) and Macon, (Geo.), the time of commencing is fixed as early as 11 o'clock; while at many places between these, the beginning was much later; indicating that the descent of meteors, at a given stage of their exhibition, was not equally copious upon all places lying in the same meridian.

A more accurate point of time is that at which the phenomenon reached its maximum. This was at places very remote from each other, as Brunswick (Maine) and Cuyahoga Falls (Ohio), about 4 o'clock,—a point of time which is also noted as the most remarkable at places situated variously between these. This fact, therefore, appears to have some connexion with difference of longitude; otherwise we should expect to find the corresponding times at an earlier hour of the night, in advancing from east to west at the rate of an hour for every fifteen degrees of longitude. It is, therefore, a fact to be particularly noted, that the phenomenon at a given stage, as at the maximum, for example, appeared to places differing in longitude 10, 20, 30, or 40 degrees, *at the same hour of the night;* as it will have an important bearing on the question, whether the origin of the meteors was terrestrial or astronomical.

In most places the meteors disappeared only because they were merged in the light of day; but in a few instances, their number began sensibly to diminish soon after day break, while it was still too dark to ascribe the diminution to the advancing light of the sun. The extreme limits of the observed duration were about eight hours.

3. Of the three *varieties* of meteors, it appears probable that the first, namely, those which exhibited streaks of light or "phosphoric lines," were much nearer the earth than either of the other kinds. One gazing into space, however, in the night, with no measure of distance in view, is liable to the greatest errors of judgment; and those who reached out their hands to grasp the luminous bodies, as some are reported to have done, remind us of young children reaching out for the moon.

It is natural enough to refer the uniform westerly tendency of this variety of meteors, to the effect of the earth's diurnal revolution,—a circumstance which would affect most such as approached nearest to the earth. Was the transient streak of light, which each described, owing to the great *velocity* of the luminous body, leaving its trace on the eye, like a stick burnt at the end and whirled in the air?

The second variety, or those which assumed the appearance of balls of fire gliding down the vault, were undoubtedly, at a much greater distance. If any of these can be identified by the peculiarities of their appearance, or that of their trains, we may hope to obtain data for estimating their height at the time of forming these trains, that is, at the time of their apparent combustion. Comparing the time, the direction, and the successive aspects of the train, in the case of the meteor described by the writer as exploding near Capella, (See p. 365.) it appears probable that this was seen by Mr. Barber at Frederic, Maryland, by Mr. Tomlinson at Brookfield, a few miles north west, and by Dr. Lee at New Britain, a few miles north east, of New Haven, and by Lieutenant Crane at West Point. On the supposition of the identity of the body seen by these different observers some attempts have been made, both by Mr. Twining and myself, to estimate its height. The calculations are not yet sufficiently matured to be submitted to the public. The result already obtained, however, leads us to believe that even the point at which the trains were formed, was many miles above the earth. Should it appear probable, that the small clouds or nebulæ into which many of these fire balls were finally resolved, were actually borne eastward by the wind, as they appeared to be, it would be an interesting and instructive fact, in respect to the height to which the wind that prevails at the surface of the earth sometimes extends into the atmosphere.

Were the trains and nebulæ merely smoke, produced by the combustion of the meteors from which they resulted, rendered luminous by being elevated above the earth's shadow into the region of the sun's light?

The few remarkable bodies, which are described, as remaining for a long time stationary in a particular part of the heavens, present anomalies which even conjecture is hardly competent to reach. We shall require more specific facts before we can attempt an explanation.

4. The *sounds* supposed to have been heard by a few observers, are (with the exception of the loud explosion said to have been heard off Charleston,) represented either as a *hissing noise*, like the rushing of a sky rocket, or as slight explosions like the bursting of the same bodies. These comparisons occur too uniformly, and in too many instances, to permit us to suppose that they were either imaginary or derived from extraneous sources.

5. It is obvious that a great variety of circumstances might influence the *direction* of the meteors. On the supposition that they descended from the higher regions of the atmosphere merely by the force of gravity, if they had fallen from a small height like drops of rain, they would have appeared to proceed from the zenith of the spectator upon well known principles of perspective. If they had fallen from a great height in the upper regions of the atmosphere, they would have had a tendency eastward by their own inertia, the velocity of diurnal motion being greater in the upper regions of the atmosphere than at the surface of the earth. Their di-

rection might also be somewhat modified by the course of the wind. On the supposition that their origin was in a region of space beyond the limits of the atmosphere, where they would not partake of the diurnal motion, then on descending to the earth, they would receive a westerly tendency by their inertia, (not instantly acquiring the easterly motion of the earth,) which relative tendency would be still farther modified by the motion of the earth in its orbit, and by the proper motion belonging to the bodies themselves, if they had such a motion in space. In short, the actual direction would be the *resultant* of all these forces. On either of the foregoing suppositions the apparent might become very different, and even directly opposite to the actual directions, by the manner in which they were projected on the celestial vault in consequence of the position of the spectator, a point which may be more fully illustrated hereafter by means of diagrams.

6. The *fixed position, in respect to the stars of the apparent radiant*, we may now consider as established by the concurrent testimony of all those observers who noted its place among the stars, so far as we have been able to obtain their statements. We subjoin extracts from several letters which we have received, in relation to this point, it being premised that all our correspondents had, in their communications, previously mentioned that the radiant point was observed in the constellation Leo.

Mr. Twining of West Point, in a letter dated Nov. 30th, says, "my opinion is, and has been, that although the luminous appearances were within our atmosphere, the source or cause lay far beyond. My own impressions were, that the radiant point did not partake of the earth's rotation, and I named them on the day of the 13th, to a Professor in the West Point Academy. In the course of debate, we both thought it so improbable, that I was about giving up the idea, as the light had dimmed the phenomenon before I attempted a second location of the radiant."

Mr. Barber, of Frederick, Md., under date of Nov. 29th, observes: "In answer to your question, I say with confidence that, from my first observation, at a little before half past 5 o'clock, till the meteors were overpowered by the light of day, there was to the eye no perceptible variation of the seeming radiant point."

Professor Aiken, of Emmittsburg, Md., in a letter of Dec. 18th, says, "the radiant point was first noticed by myself about a quarter before 5 o'clock, at the latest, and it might have been a few moments earlier. It maintained the same relative position in regard to Gamma Leonis during the whole time of observation, that is, till the light of day obscured the meteors, a space of about two hours. I am confident if it had moved five degrees, in any direction, I should have observed it, as my attention was, for various reasons, fixed upon that point. It was to the *north and west* of Gamma Leonis, and by reference to the celestial globe would not have been, when on the meridian, more than 15 degrees south of the zenith.

"The words 'probable proximity,' occurring in my letter, (see p. 374.) referred to the possibility of the meteors being within our atmosphere; the phenomenon, if at all explicable, seeming to me more easily so, if the theatre of action could be located near us. It is needless to add, that my supposition is wholly untenable, when opposed by the inferences you deduce from the stationary position of the radiant,—inferences which did not strike me at the time, and which are therefore perhaps felt with greater force at present."

Mr. Scott, of Providence, (who wrote an anonymous description of the phenomenon in the Providence Journal, but whose testimony we have been able to obtain from Professor Caswell,) "thinks that it was at least half an hour before the disappearance of the meteors, that he fixed the position of the radiant point. During that interval, it did not sensibly vary with respect to the stars."

Mr. *John L. Riddell*, of Worthington, (O.) author of the description on page 377, in a letter of Dec. 21, observes: "It first occurred to me to determine the location of the point from which the meteors seemed to radiate, a little before 5 o'clock. At 5, the Right Ascension of this point was near 149°, and its Declination 21° 45′.* Twenty minutes later, the R. A. was about 151°, Dec. 21° 30′, nearly. From this time, until the exhibition was rendered invisible by the light of day, the center of radiation seemed to retain nearly the same place in the heavens, moving westward with the fixed stars. Those who saw this phenomenon very early, assert that the stars seemed to shoot down from the zenith; but I do not place much reliance upon these accounts.†

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* Therefore a little west of *Gamma* Leonis, not *Delta*, as mentioned on p. 377.

† In reply to certain other queries submitted to him, Mr. R. remarks: "I have regretted that it was not in my power to make magnetic observations at the time; though I do not believe terrestrial magnetism had any influence. In regard to a luminous body, mentioned by your correspondents of the Western Reserve, as seen in the north-west, I cannot learn that it was observed at this place. A little before

One reason probably, why so many persons referred the radiant point to the zenith, is that most persons began their observations when the constellation Leo was near the meridian; and we have already adverted to the liability of observers to consider points of great altitude as nearer the zenith than they really are, on account of the difficulty of looking directly upwards. In the Gulf of Mexico, Capt. Parker, saw the radiant point at 3 or 4 o'clock in the *northeast*, at an altitude of 45°; and Capt. Seymour, of the De Witt Clinton, descending the Hudson river, saw the radiant point at an altitude which he judged to be about 45° S. E.*

7. If the apparent radiant point from which the meteors proceeded was merely the effect of perspective, no inference could be made respecting the *height* of the region from which they came; as the same apparent convergence of the distant parts of parallel lines would be presented, whether the lines were one mile or a thousand miles in length. Such an apparent convergence, or radiation, in itself, merely proves that the lines are nearly or entirely parallel. But if the meteors came from a region of space, being attracted towards the earth by gravity, in lines directed towards the center of the earth, and therefore within a moderate space parallel to each other, then the convergence of such lines to a focus would indicate the position of that focus in the heavens; and this position being accurately noted by different observers, at places remote from each other on the surface of the earth, the height of the place whence the meteors originated, can be determined, unless that height be too great to exhibit any parallax. In the present instance this does not appear to be the case; for the radiant point as observed by Dr. Aiken, at Emmittsburg, and by the writer, at New Haven, had a parallax of about 3° 40′ in declination.

It is to be remarked that, although the several observers who fixed the position of the radiant among the stars agreed in plaçing it in the constellation Leo, yet the distant observers did not assign it to the same part of Leo. At New Haven, it appeared a little to the westward of *Gamma* Leonis having a declination of 21°. At Emmittsburg, it was north and west of the same star, with a declination of

5, a very large meteor burst in the south-east, and gave origin to a luminous cloud, which remained visible from 30 to 40 minutes. We had no appearance of the aurora borealis, nor can I learn that any of the fire balls were seen to ascend."

* Mr. Twining.

24° 40′. At Worthington, it was very near Gamma Leonis, a little westward of it, having a declination of 21° 30′, and having therefore, when compared with the observations of Dr. Aiken, a parallax in declination of 3° 10′.

The observations of Capt. Parker in the Gulf of Mexico, will afford when compared with ours, a still greater parallax. (See. p. 400.)

8. For want of good observations, it will be difficult to form a correct estimate of the *size* of any of the meteors, since a judgment formed by the unassisted eye, upon bodies so transient and so brilliant, is very liable to be erroneous; but the distance of a fire ball, at the time of its disappearance, being determined, some approximate knowledge may be gained of its dimensions from the apparent diameter of its nucleus. According to most observers, these fire balls had each a distinct nucleus, the size of which many compare to the largest apparent dimensions of Jupiter and Venus, which it exceeded, and in one or two instances it appeared nearly equal to that of the moon.

Similar remarks might be made respecting the dimensions of the luminous trains. Moreover, on the supposition that these trains, and the nebulæ into which they occasionally resolved themselves, were formed of smoke that originated from the combustion of the meteors, we are led to infer that the meteors themselves were constituted of matter not aeriform, but of a density corresponding to that of a liquid, or perhaps even of a solid body.

9. It seems difficult to determine whether or not any substance was found, that was probably a *deposit* or *residuum* from the meteors. The fact, however, that the supposed deposits were so uniformly described as *gelatinous* substances, forms a presumption in favor of the supposition that they had the origin ascribed to them. This quality, it is worthy of remark, was mentioned by observers of very different classes, some of whom (as in the instance mentioned by Mr. Twining, p. 396) could hardly be supposed to have ever heard, that to fire-balls of this description had been assigned such a chemical constitution.

Taking it as established, that such a residuum as has been mentioned, was deposited by the meteors, we may infer, that the matter of which the meteors were composed was both highly volatile and transparent,—qualities that are apt to be united in very inflammable substances. We know of hardly any thing else, except bodies analogous to the metallic bases of the alkalies, potassium for example, which could have undergone combustion under the circumstances in which the meteors appeared to undergo this process. Could bodies constituted like known äerolites, falling from any supposed height in space into the atmosphere, generate heat sufficient, by the abrasion or condensation of the air, to dissipate them in a cloud of smoke before they reached the earth?

If we could establish the affirmative of this question, we should at once be able to trace the ground of connexion between phenomena of this kind and magnetism, since äerolites are known to consist in a great measure of native iron. A number of other very interesting results would follow, respecting the aurora borealis.

10. That the air was in a state unusually favorable to the development of *Electricity*, is very evident from the facts recited on p. 397. Such a state of the atmosphere is always consequent on so sudden a change of temperature and humidity from warm to cold, and from wet to dry. The air thus becomes a more perfect insulator, and electricity is accumulated on various bodies, from which it is given out in sparks on the approach of an uninsulated conductor, or emitted in streams to the air itself as soon as that becomes humid again. The fact that such electrical appearances were unusually striking at the time of the occurrence under review, and a few hours after, being granted, we should still have to inquire, whether the electricity were a cause or a consequence of the meteors, or whether it were merely a subordinate effect of the change of weather.

Similar remarks may be made with respect to any magnetic influence which may have been detected. Should a connexion be traced between the apparent motions of the meteors and the laws of terrestrial magnetism, this discovery would throw light on the *motions* of these bodies, but would still leave the greater part of the difficulties, such as their nature and origin, unsettled.

But the known connexion of the *aurora borealis* with terrestrial magnetism, and the obvious connexion of the phenomenon in question with auroral appearances, afford reasonable grounds for examining the magnetic indications with the greatest attention; considerations, which add to the regret already adverted to, that so few magnetic observations have been communicated to the public.

11. Of the several facts collected under the head of *concurrent phenomena*, possibly no one may prove of any importance; and yet the contrary is also possible. The fall of rain without clouds

at Harvard, was an interesting meteorological fact, and may have had a strict connexion with the meteors, a connexion which may be more fully developed when the cause of meteors shall be better understood. The luminous appearances in the west following twilight, are also remarkable. The same appearance has been exhibited as late as the evening of December 29th, in a form much more imposing than on either of the preceding occasions. It was observed immediately after the twilight, (which ended at eighteen minutes after six,) and lasted until fifteen minutes before eight. It illuminated all the western sky and strongly resembled the twilight, being brighter than the zodiacal light, not lenticular like that, and not extending along the Zodiac, but having its apex in a vertical circle near Alpha Pegasi. Ridges of dark clouds, (cumulo-stratus) with intervals of clear sky, contributed to heighten the effect by contrast; and higher than these, was a thin vapor that became visible as it crossed Jupiter, which was near the meridian, being illuminated in a circular space around the planet, and presenting much the same appearance as the light in the west, a circumstance which led to the conjecture that the latter was owing to the same vapor elevated so high as to fall into the sun's light, after the ordinary cause of twilight had ceased to operate. The vapor was so thin as hardly to diminish the light of Jupiter. Was this vapor such as remained from the combustion of the meteors?

An aurora borealis of moderate height was visible in the north at the same time, and faded away simultaneously with the western aurora.

12. It has been thought an object of so much importance, to present a full view of the facts which have reached us, as noticed by a great number of intelligent and accurate observers in various parts of our wide country, and the neighboring parts of the ocean, that we have already, through the indulgence of the Editor, been permitted to swell this number of the Journal beyond its ordinary dimensions; although we have not yet entered upon the two last heads proposed, namely, to give a historical sketch of the same phenomenon as it has appeared before at different times, and, finally, with the whole body of facts before us, to inquire what explanation, if any, can be given of them. These topics must be reserved for the next number of the Journal.

At least four hypotheses proposing to account for the facts in question, are already before the public. Electricity, Magnetism, the Combustion of Hydrogen Gas, or of some of its compounds, and Terrestrial Comets, have severally been made the basis of explanations. Whether one or more of these causes will satisfactorily account for the facts, or whether a full and careful survey of the phenomena will lead us to conclusions subversive of them all, are points which will of course require considerable discussion.

We regret the less being deprived of the opportunity of pursuing this discussion at the present time, because when we shall have heard of the phenomenon as it presented itself in the far west, (perhaps to the Pacific Ocean, or to the confines of Asia,) and along the northern and southern limits of countries where it was visible, we may be furnished with additional facts that will either correct or strengthen our present opinions, and add greatly to our means of arriving at the truth.

(To be continued.)

MISCELLANIES.

FOREIGN AND DOMESTIC.

1. *Notice of the "British Association for the Advancement of Science.*—Through the kindness of Mr. Mantell, of Lewes, Eng. and of Prof. Buckland, of the Univ. of Oxford, we have received, in a quarto pamphlet, an account of the third meeting of the British Association for the Advancement of Science, which took place at Cambridge University in June, 1833. This notice is rendered the more interesting, by the autographs of the members.

This association which has been in existence but three years, now numbers among its members a great proportion of the men of science throughout the United Kingdoms. Several distinguished foreigners were present, and we are happy to notice among them, the names of a number of gentlemen and scholars from the United States.

Such an annual association, of learning, talent, rank and wealth, cannot fail to produce the most important results. What scene could be more exciting than to meet a thousand of the votaries of philosophy in a noble palace, long since consecrated to "science and good learning," and in the very hall of Bacon. They met at the same table where these men met before, the same anthem was heard* at this magnificent festival which had been heard by them; "and every thing around was made venerable by the remembrance of departed genius." To the philosophical student it must have been a high gratification and encouragement to find his efforts appreciated, and to be

* It is a custom of the college to sing this anthem on festival days.

himself welcomed as a fellow laborer in such exalted pursuits, by those masters in science, who enjoy the accumulated facilities of ages, for pursuing every inquiry after truth. The association will meet at Edinburgh, in September, 1834.

2. *Prize Medals to be awarded for discoveries in Science, by the Royal Society of London.*

To Professor Silliman.

Philadelphia, Dec., 13, 1833.

Dear Sir.—I am directed by the American Philosophical Society of this city, to communicate to you for publication the annexed letter received at a late stated meeting. The object of the Society is to diffuse the information, given in the letter, throughout the scientific community in the United States. Very respectfully yours,

A. D. Bache, *Secretary.*

London, August, 3d. 1833. Somerset House, Apartments of the Royal Society.

Sir.—I am honored with the commands of his Royal Highness, the President of the Royal Society, to acquaint you for the information of the American Philosophical Society at Philadelphia, that his Majesty, the King, has been pleased to grant two gold medals of the value of £50, each, to be awarded by the Royal Society, on the day of their anniversary meeting in each succeeding year, for the most important discoveries in any one principal branch of Physical or Mathematical knowledge.

His Majesty, having expressed a wish that scientific men of all nations should be invited to afford the aid of their talents and researches, I am accordingly commanded by his Royal Highness, the President, to announce to you, Sir, that the said Royal medals for 1836, will be awarded in that year ; the one for the most important unpublished paper in Astronomy, the other, for the most important unpublished paper in Animal Physiology, which may have been communicated to the Royal Society for insertion in their Transactions, after the present date and prior to the month of June in the year 1836.

For the present, and the two following years, the council of the Royal Society, with the approbation of his Majesty, the King, have directed the Royal medals to be awarded for important discoveries or series of investigations published within three years previous to the time of award; and those for the year 1833, have been adjudged, the one to Sir John F. W. Herschel, for his papers on the investigation of the orbits of revolving double stars, inserted in the 5th vol. of the Memoirs of the Royal Astronomical Society; the other to Professor Decandolle, for his investigations in Vegetable Physiology as detailed in his work entitled Physiologie Végétale.

I have the honor to be Sir, your most Obt. Servt.

Charles König, For. Sec. R. S.

To the Secretary of the American Philos. Soc. Philadelphia.

3. *Pink dye from the flower of the sweet balm.*

Read before the Lyceum of Nat. Hist., N. York, July, 1833; by WM. PARTRIDGE.

I beg leave to present to the Lyceum a specimen of pink colored silk made from the flowers of the sweet balm (Monarda didyma). Such colors are usually made with safflower, (Carthamus tinctorius) which is imported from the East Indies and from the Levant.

In making this pink, I used six grains of balm flowers, and three grains of alum, the silk weighing twelve grains. After drying, it was passed through a weak solution of citric acid in water. In making a similar color from safflower, the flowers are secured in a linen bag, washed and pressed in running water, until all the yellow color is washed away. The flowers have now to be macerated in a solution of soda, sufficiently strong to dissolve the pink coloring matter. The soda has then to be neutralized by citric acid. This complicated and expensive process makes safflower pinks more costly than even cochineal colors.

The sweet balm is a native of North America, grows very freely, and will in three or four seasons, from a few roots, spread itself over a large tract of ground. It keeps blossoming nearly all the summer, and, from the flowers saved from a few heads, would, undoubtedly afford a large crop of dyeing material from a small surface of land.

The utility of this new coloring matter, is, however, more restricted than that from the carthamus, as the former makes no impression on cotton, whilst the latter operates equally well on both cotton and silk.

It is highly probable that still more beautiful tints might be obtained from those flowers, by trying them with the various mordants singly and combined; but I have not time to follow out so tedious and expensive an operation.

4. *Contributions to Geology:* by ISAAC LEA, 8vo. p. 226. Philadelphia, 1833.—The geology of the United States, has indeed

received some valuable contributions the present year. The simultaneous appearance of two considerable works devoted to the descriptions of rocks and fossils, has not hitherto marked the American history of this science. The other work alluded to, is Professor Hitchcock's Geological Report of Massachusetts, whose author from the nature of his region has confined himself to the elucidation of non-fossiliferous rocks, while Mr. Lea, has been led to investigate some of the more recent, or semi-organic, formations: the former of these naturalists having, as was fit, entered upon his researches through the portals of mineralogy, while the latter has made a no less felicitous *début* as a conchologist. Mr. Lea's investigations, concerning our fresh water shells, particularly the family of them denominated the *Naiades* has rendered his transition to the study of extinct shells as easy, as we have no doubt it has been successful. Not that we are prepared to vouch, that out of two hundred and fifty supposed species, afforded by a single bluff, two hundred and nineteen are new, as Mr. Lea supposes; though better means than we at present possess, added to the well earned reputation of the author, must for the present restrain us from calling in question so extraordinary a discovery.

The following is Mr. Lea's table of contents; viz. "Tertiary Formation of Alabama, New Tertiary Fossil Shells from Maryland and New Jersey, New Genus of Fossil Shell from New Jersey, Tufaceous Lacustrine Formation of Syracuse, Onondago County, New York:" although it must be remarked, that about two hundred pages are devoted to the first of these topics.

The introduction embraces a rapid sketch of the developement and occurrence of organic productions in the earth's strata. Omitting his remarks upon the transition and secondary fossils, we commence our extracts with his explanation of Mr. Lyell's denomination of the three periods admitted by geologists to exist in the Tertiary; viz. the *Pliocene* period, the *Miocene* period, and the *Eocene* period.

"The first is derived from the Greek words πλειων major and καινος recens, as most of them are recent species and of course of later deposit. This he subdivides into the Newer and Older Pliocene, in which M. Deshayes, does not agree with him. The second Miocene, is, from μείων minor, and καινος recens, there being here a minority of recent species. The third, the Eocene, is derived from ἠως aurora, and καὶνος recens, this being the *dawn* of the existing state of the animate creation.

"In the lowest of these, the Eocene period there have been observed in Europe, one thousand, two hundred and thirty eight species; of which the very small number, of forty two, have been identified with recent species. Of fossil species not known as recent, forty two are common to the Eocene and Miocene epochs.* It is remarkable too, that the living species are rarely the inhabitants of the shores of those countries in which they are found in a fossil state, inhabiting now more southern climates.

"The next period of deposit, that of the Miocene, is a formation distinct in its characters from the London clay below, and the English Crag above it. In it, M. Deshayes, has observed one thousand and twenty one species, one hundred and seventy six of which are found in a recent state.

"Superior again to this in the Pliocene period, we find the recent species comparatively abundant. Mr. Lyell, in dividing this into older and newer Pliocene, observes, 'the plurality of living species is so very decided.' The former includes the Sub-appenine hills and the English Crag; the latter the Sicilian beds.

"It has been stated that forty five hundreths of the species found in the English crag exist in a recent state; while in the Sicilian beds, according to Mr. Lyell, ten only out of two hundred and twenty six are extinct, or unknown, nearly the whole of them existing at the present time in the neighboring seas.

In addition to the marine reliquiæ, the remains of terrestrial mammiferous animals afford us, in the tertiary formation, a striking proof of the extraordinary change which has taken place. Of the numerous species, the remains of which are there found, none now exist. More than forty of the Eocene mammifers, are referable to a division of the order Pachydermata, which has now only four living representatives on the globe; of these not only the species but the genera, are distinct from any of those which have been established for the classification of living animals. "The mammalia of the Miocene agree in some of the genera with recent animals, and those of the Pliocene are an intermixture of extinct and recent species of quadrupeds."

Superior and next to the tertiary is De la Beche's erratic block group, and above it, his modern group. These two are embraced in Mr. Lyell's recent period, and here are found to exist the remains

* Principles of Geology, Vol. 3. p. 55.

of those large animals, the *mastodon*, *hippopotamus*, *megatherium*, *rhinoceros*, *&c.* To this recent period, belong the causes which are now so evidently in action, and with which we are familiar, such as the formation of coral reefs and islands, deltas, travertins, active volcanoes, &c.

"Viewing these changes the facts of which have been established by the united exertions of geologists, within a comparatively short period, we reflect with intense interest on the disappearance from our planet of an immense number of species, numerous genera and even some families!

"The cause of the vast changes which it is evident to our senses have taken place, are among the most interesting which have engaged the attention of mankind. Theories of all kinds have been promulgated, and little good has arisen from them, except that of the gradual development of facts, the accumulation of which has added to our stock of knowledge. It is said to be Fuchsel (a German geologist,) who first asserted that the causes now in operation were sufficient to produce the changes observed in our strata. 'Similar changes may now take place; *for the earth has always presented phenomena similar to those of the present day.*' Such is the remarkable language of the author, published about seventy years since. Very recently the theory of actual causes has been considered in England by some of her ablest geologists, as sufficient to satisfy the attentive observer. Mr. Lyell may now be considered as the leader of this theory, and the mass of facts brought together in his admirable work, would seem to be enough to satisfy the most sceptical.

"The rapid change which is now going on in the greatest altitudes of Switzerland, points out to us the modes in which nature is operating by decomposition, and the attraction of gravitation. When standing on the borders of the Mer de Glace, and while crossing its frozen bosom, this operation was brought most forcibly to my mind. Every moment my ears were saluted with the sound, more or less distant, of rocks precipitated from some height into the abysses below, and which reverbated over this frozen sea. The time may come when the pinnacles of Mont Blanc and other mountains, which surround the beautiful valley of Chamounie, will have been precipitated to their bases, and the dèbris be so completely carried off as to leave, perhaps, that beautiful and fertile spot itself, the highest pinnacle of the country; a naked rock to be gazed at from a distance.

"Perhaps the most difficult point to solve, is that which presents itself in the fact, that deposits in high latitudes contain animal and vegetable remains, presumed by analogy to be unable to exist in their temperature at the present period. A change in the earth's axis, would, of course affect the temperature of its surface, but whether that can take place under any known law in a sufficient degree to effect such a change, has certainly not been established. Sir John Herschel, has supposed that a change of temperature might take place in the change of the elliptical orbit of the earth, which becomes gradually more circular."

The Tertiary deposit in particular, which has formed so rich a harvest for Mr. Lea, is situated at Claiborne, on the east side of the Alabama river, about ninety miles in a direct line from the Gulf of Mexico. It was made known to him by Judge Tait, a citizen of that place, in January 1829, from whom he received samples before the close of the year, and in the year following, an additional supply, together with some notices of their mode of occurrence. These would have been made public at an earlier period but for the occupation of Mr. Lea, with the examination of recent shells.

From Judge Tait's observations, it appears, that this formation which at Claiborne, attains an elevation of two hundred feet, spreads through the whole of South Alabama, (its southern edge commencing about ten miles south of Claiborne bluff) and extends as it is believed through the whole of the States of Alabama, Mississippi, and terminates only in the Chickasaw Bluffs of West Tennessee.

The Alabama river passing under the bluff of Claiborne, reveals a fine section for geological observations, of which no doubt Judge Tait availed himself in the descriptions he gives of the successive strata. Beginning at the bottom we are first presented with a bed having the thickness of one hundred and twenty feet, which Mr. L. calls a soft calcareous rock, through which are occasional scales of mica and sprinklings of calcareous matter together with numerous fragments of shells consisting generally of *Flustræ, Cardiæ, Corbulæ, Ostræ, Volutæ, Naticæ and Turritellæ,* but the fragments were too friable and imperfect to admit of more satisfactory determination. He hesitates whether, upon this amount of information to include it in the Tertiary, or to refer it to an earlier origin. The next stratum in the ascending series, and which is closely related to the foregoing, is a more compact calcareous rock containing micaceous grains of dark green sand, a single and imperfect valve of a large *Ostrea,* a *Teredo* and some *Flustræ.* It is only two feet in thickness. Above this rests the depository of the fossils described in such abundance in the present work. The bed is seventeen feet in thickness. It is composed of a loose, quartzy sand of a brownish color: the grains of which are small and angular, and so slightly coherent as to permit the extrication of the most delicate of its imbedded shells. The next stratum distinguished, is only about eighteen inches in thickness, consisting of a friable rock, easily separating into irregular pieces, and like the subjacent one, composed of quartzy sand; but whose grains instead of being angular, are rounded, being held together through the intervention of carbonate of lime. It contains casts of several shells, among which were detected, *Avicula*, *Venus*, *Crepidula* and *Turritella.* Above this, reposes a thin layer, two feet in thickness, composed of sand and shells slightly adhering by means of an argillo-ferruginous cement which imparts a reddish brown stain to the aggregate. The calcareous matter of the shells is so much decomposed as to render it almost impossible to remove them from the surrounding matter. *Avicula*, *Venericardia*, *Nucula*, *Venus*, *Teredo* and a few others were noticed among its imbedded fossils, as was also, the *Scutella crustuloides* (Morton.) This layer and the preceding are therefore with propriety believed to belong to the same epoch with the stratum so rich in fossils, upon which they rest. Superior to these comes on, at the depth of forty five feet, the formation, commonly called in Alabama, "the *rotten limestone.*"

It is an indurated marl containing scattered masses of dark green sand, and contains *Corbulæ*, *Nuculæ* and some other bivalves which could be identified with fossils in the three lower beds. "A small and very thin *Pecten* with delicate ribs seemed the only shell which left its trace in a calcareous state. On each side of the fracture a silvery whiteness marks the deposit of this thin and fragile species. Superior to the present stratum, which may be considered as the cap of the Tertiary, is found the Diluvium of the country, forming a mantle about twenty feet in thickness, composed of sand and gravel mingled with clay.

Mr. Lea, unhesitatingly refers the rich fossiliferous stratum and its superior members to the same period as the London Clay of Fngland and the Calcaire Grossier of Paris, remarking, that this deposit is composed of siliceous sand, while that of the London Clay is argillaceous and the Calcaire Grossier is calcareous. It will therefore fall within the Eocene period of Mr. Lyell.

The fossil stratum referred to, has afforded the author, only from the specimens sent him on four or five occasions by Judge Tait, more than two hundred and fifty species, out of which seven are not referable to any known genus, and two hundred and ten species (besides nine species of *Polypi*) are not referable to any known species: and "it is an extraordinary fact, that among the whole of them there cannot be, with absolute certainty, a single species found to have its analogue in a living species. Some of the genera, are unknown on our coast; some are found only in a fossil state in Europe;" and the author doubts whether a single species is strictly analogous to those of the Eocene period of Europe, but nevertheless infers the identity of its epoch with that formation from the number of turrited shells and similar genera. Besides the shells there were found among the sand, shark's teeth of several different forms, part of a claw of a species of *Cancer*, some fragments of a fossil similar to what *Brander* figures under the name of *Palatium piscium*, and the tooth, spine and vertebræ of fish.

Annexed, the reader will perceive is the list of the new fossil shells of this remarkable locality.

CLASS POLYPI.

Family Milleporadæ.

Lunulites Bouéi.
Duclosii.
Orbitolites interstitia.
discoidea.

Family Lamelliferæ.

Turbinolia Maclurii.
Stokesii.
Goldfussii.
nana.
pharetra.

CLASS ANNULATA.

Family Dorsalia.

Siliquaria Clairbornensis.

Family Maldania.

Dentalium alternatum.
turritum.

Family Serpulea.

Spirorbis tubanella.
Serpula ornata.

Family Tubicolaria.

Teredo simplex.

Family Solenacea.

Solecurtus Blainvillii.

Family Myaria.

Anatina Claibornensis.

Family Mactracea.

Mactra dentata.
Grayi.
pygmæa.

Family Corbulea.

Corbula Alabamiensis.
Murchisonii.
gibbosa.
compressa.

Family Lithophaga.

Byssomia petricoloides.

Family Nymphacea.

Egeria rotunda.
inflata.
nitens.
triangulata.
Bucklandii.
subtrigonia.
veneriformis.

Egeria ovalis.
plana.
nana.
Lucina compressa.
rotunda.
cornuta.
impressa.
papyracea.
lunata.
Gratelupia Moulinsii.
Astarte recurva.
Nicklinii.
sulcata.
parva.
minor.
minutissima.

FAMILY CONCHÆ.

Cytherea globosa.
comis.
Hydii.
subcrassa.
trigoniata.
minima.
Venericardia transversa.
Sillimani.
rotunda.
parva.

FAMILY CARDIACEA.

Hippagus isocardioides.
Myoparo costatus.

FAMILY ACACEA.

Arca rhomboidella.
Pectunculus Broderipii.
minor.
deltoideus.
ellipsis.
obliqua.
Nucula Sedgewickii.
ovula.
pectuncularis.
Brongniarti.
media.
pulcherrima.
plicata.
magna.
carinifera.
Nucula plana.
semen.

FAMILY MALLACEA.

Avicula Claibornensis.

FAMILY PECTINIDA.

Pecten Deshaysii.
Lyelli.
Plicatula Mantellii.

FAMILY OSTRACEA.

Ostrea semilunata.
divaricata.
Alabamiensis.
lingua-canis.
pincerna.

CLASS MOLLUSCA.

FAMILY CALYPTRACIANA.

Fissurella Claibornensis.
Hipponix pygmæa.
Infundibulum trochiformis.
Crepidula cornu-arietes.

FAMILY BULLAEANA.

Bulla St. Hillairii.
Dekayi.

FAMILY MALANIANA.

Pasithea secale.
notata.
lugubris.
aciculata.
striata.
sulcata.
umbilicata.
guttula.
Claibornensis.

FAMILY NEVITACEA.

Natica striata.
parva.
minor.
minima.
gibbosa.
semilunata.
magno-umbilicata.
mamma.

FAMILY PLICACEA.

Acteon punctatus.
lineatus.
elevatus.

melanellus.
striatus.
pygmæus.

FAMILY SCALARIANA.

Scalaria planulata.
carinata.
quinquefasicata.
Delphinula plana.
depressa.

FAMILY TURBINACEA.

Solarium bilineatum.
Henrici.
ornatum.
elegans.
cancellatum.
granulatum.
Orbis rotella.
Planaria nitens.
Turbo naticoides.
nitens.
lineatea.
Tuba striata.
alternata.
sulcata.
Turritella carinata.
lineata.

FAMILY CANALIFERA.

Cerithium striatum.
Pleurotoma cælata.
Lonsdalii.
Sayi.
monilifera.
Baumontii.
Desnoyersii.
Hæninghausii.
rugosa.
obliqua.
Childreni.
Lesueurii.
Cancellaria Babylonica.
multiplicata.
plicata.
sculptura.
tessellata.
elevata.
costata.
parva.
Fasciolaria plicata.
elevata.
Fusus pulcher.
Mortonii.
decussatus.
bicarinatus.
venustus.
crebissimus.
magnocostatus.
Delabechii.
ornatus.
acutus.
Conybearii.
nanus.
Fittonii.
parvus.
minor.
Taitii.
Pyrula cancellata.
elegantissima.
Smithii.
Murex alternata.

FAMILY ALATA.

Rostellaria Lamarckii.
Cuvieri.

FAMILY PURPURIFERA.

Monoceros pyruloides.
fusiformis.
sulcatum.
Buccinum Sowerbii.
Nassa cancellata.
Terebra gracilis.
costata.
venusta.

FAMILY COLUMELLARIA.

Mitra lineata.
minima.
fusoides.
Flemingii.
Humboldtii.
Voluta Defrancii.
gracilis.
parva.
Vanuxemi.
striata.
Parkensonii.
Cooperii.

Marginella anatina.
columba.
crassilabra.
plicata.
semen.
ovata.
incurva.
biplicata.

FAMILY CONVOLUTA.

Anolax gigantea.
Anolax plicata.
Oliva constricta.
gracilis.
Greenoughi.
dubia.
Phillipsii.
minima.
Monoptygma Alabamiensis.
elegans.
Conus Clairbornensis.

The new genera of Mr. LEA, it will be observed, are *Egeria, Hippagus, Myoparo, Pasithea, Orbis, Tuba*, and *Monoptygina.*

That these innovations in nomenclature, and the still more numerous ones in the species, are destined to stand, unmodified, the test of future investigations, may perhaps excite a doubt in the mind of the cautious naturalist; but we entertain too high an opinion of the author, to believe for a moment, that he has been seduced by the idle ambition for imposing new names; and we doubt not, if a farther development of the locality at Claiborne, and a more copious supply of specimens, shall demonstrate the inter-transition of some of his species, that he will show himself no less forward to relinquish, than he has, apparently, been, to propose. In the mean time, however, every geologist who takes an interest in the study of the fossiliferous formations of North America, will feel grateful for the very minute and faithful descriptions contained in this work, and for the exquisitely engraved figures by which every one of his species is illustrated.

We owe too, many thanks to the scientific curiosity and generous labors of Judge Tait. And we sincerely wish that other individuals in his section of the country would emulate his example; and thus attract to their neighborhoods, the attention of the scientific throughout the world. It is safe to say, that Claiborne is, for the present, the most remarkable spot to the geologist in Alabama, whatever may be its importance in other respects.

The new Tertiary fossil shells from Maryland and New Jersey, are as follows:

Balanus Finchii, from St. Mary's, Maryland.
Mactra clathrodon, do.
Acteon Wetherilli, Deal, New Jersey.
Rotella nana, St. Mary's, Maryland.
Fusus pumilus, do.
Miliola Marylandica, do.

These are from that portion of the Tertiary mass, called by Mr. Lyell, the older Pliocene Period, and were discovered about nine years ago by Mr. John Finch.

The new genus of fossil shell from New Jersey, is from the cretaceous deposit of Timber Creek. It falls within the family of Spherulacea of Blainville. It approximates most to the genus Saracenaria of Defrance. Mr. Lea calls it *Palmula*, from its palmate figure; the species is denominated *sagittaria*.

The concluding contribution to geology, afforded by this volume, relates to a very recent Tufaceous, lacustrine formation, near Syracuse, Onondaga county, New York, observed by the author some years since, while travelling upon the canal. It first attracted his notice as lining the banks of the canal. He describes it as a calcareous marl of a whitish color, bordering on that of ashes, as friable and rather soft to the touch. It contained numerous perfect specimens, of the genera *Lymnea*, *Physa*, *Planorbis*, *Paludina* and *Ancylus*, all of which are analogous to the species at present living in the waters of that region. The shells were completely bleached, and generally in an unbroken state. He crossed it on a line, east and west, of about two miles, but its width and depth he was unable to ascertain. A deposit of the same kind was observed near Chitteningo, fifteen miles east of Syracuse, which the hydrography of the country prevents from being considered as belonging to that first noticed at Syracuse.

Deposits of this kind are certainly worthy of every possible elucidation, both on account of their supposed variety, and the link they furnish us, by which to connect those more ancient and widely extended formations, with such as approach our own period, in the circumstances of their formation. For the purpose of eliciting further information, we would state that a similar formation, containing not only the same shells, but also embracing occasional mixtures of carbonaceous matter, resembling lignite or peat, exists in the immediate vicinity of Montreal, in Lower Canada.

5. *New Work on Conchology.*—Proposals have been issued by Russell, Odiorne & Co., Boston, for a treatise on Conchology, by John Warren. "This work will contain a comprehensive sketch of the most distinguished writers on Conchology, from Aristotle to the present day, and will form a complete history of the rise and progress of this delightful science.

"It will describe the genera according to the Linnæan arrangement, as well as the inhabiting Mollusca, with plates of the rarest of every genus, accompanied by descriptions.

"The habitats of the most rare species will be noticed, with some proper directions to the student, for preserving and cleaning the shells, as well in this country as in foreign climes.

"The genera as arranged by Lamarck and Cuvier, will be enumerated, in order to assist the collector, to which a glossary will be annexed, compiled with great care from the most valuable and the rarest works on the Science in existence.

"The work will be printed on fine paper, in a quarto form, illustrated by seventy two handsome lithographic drawings, and will be delivered to subscribers in a neat binding, at $4, plain plates, or $8 plates colored.

"The plates for this work are original, drawn expressly for the purpose, and for accuracy of delineation will be found to be equal, and in many respects superior, to those of any work ever published on the Science of Conchology."

6. *Ornithology.*—Will speedily be published, Ornithology of the United States and Canada, by Thomas Nuttall, Vol. 2. Water Birds, 1. Vol. 12mo.

7. *New Work by Dr. S. G. Morton.*—Mess. Key & Biddle of Philadelphia, have just published "Illustrations of Pulmonary Consumption, its anatomical characters, causes, symptons and treatment. With twelve plates drawn and colored from nature. By Samuel George Morton, M. D. Physician to the Philadelphia Alms House, Hospital, &c."

This work illustrates, by accurate and beautiful colored plates, the progress of tubercular consumption, from the incipient stage to open abscess. The subject is further illustrated by the details of thirty four cases, embracing nearly all the known symptoms, morbid characters and complications of this disease.

8. *Zoology.*—*Charles Lucien Bonaparte* has commenced at Rome, a work entitled *Iconographia Della Fauna Italica.* It will be contained in 20 numbers in 4to, and will be illustrated by colored lithographic drawings. The price is three Roman scudi per number, or, $60 for the twenty numbers,—*Nat. Gaz.*

9. *Recent Scientific Publications in the United States.*

Natural History of the Fishes of Massachusets, embracing a practical Essay on Angling, By Jerome V. C. Smith, M. D. 12mo. pp. vii, and 400. Boston, Allen & Ticknor.

Rambles of a Naturalist, by John D. Godman, M. D.; to which are added, Reminiscences of a Voyage to India. By Reynell Coates, M. D. 12mo. pp. 151. Philad., Thos. T. Ash—Key & Biddle.

A Compendium of Natural Philosophy; adapted to the use of the general reader, and of Schools and Academies. By Denison Olmsted, A. M., Prof. of Math. and Nat. Phil. in Yale College. 8vo. pp. xvi, and 336. New Haven, H. Howe & Co.

A New Theory of Terrestrial Magnetism. (Read before the New York Lyceum of Natural History.) By Samuel L. Metcalf, M. D., member of the N. Y. Lyc. of Nat. Hist. 8vo. pp. v, and 158. New York, G. & C. & H. Carvill.

The Philosophy of the Human Voice; embracing its Physiological History; together with a system of Principles, by which criticism in the art of Elocution may be rendered intelligible, and instruction, definite and comprehensive. To which is added a brief analysis of Song and Recitative. By James Rush, M. D. Second edition, enlarged, 8vo. pp. 432. Philadelphia, Grigg & Elliot.

The American Almanac and Repository of Useful Knowledge for the year 1834, 12mo. pp. xii, and 336. Boston, Charles Bowen.

Popular Lessons in Astronomy, on a New Plan, in which some of the leading principles of the science are illustrated by actual comparisons, independent of the use of numbers. By Francis J. Grund. 4to. pp. 24. Boston, Carter, Hendee & Co.

First Lessons in Algebra, designed especially for the benefit of Common Schools. By Ebenezer Bailey. 12mo. pp. 227. Boston, Carter, Hendee & Co.

An Introduction to Algebra, being the first part of a Course of Mathematics, adapted to the method of instruction in the American Colleges. By Jeremiah Day, Pres. of Yale Coll. Twelfth edition, 8vo. pp. viii, and 332. New Haven, Hezekiah Howe & Co.

The Geography of the Heavens, or familiar instructions for finding the visible stars and constellations, accompanied by a Celestial

Atlas, with a view of the Solar System. Illustrated by Engravings. By E. H. Burritt, A. M. Second edition, 18mo. pp. 342. Hartford, F. J. Huntington.

Contributions to Geology. By Isaac Lea, M. A. P. S., &c. Philadelphia, Carey, Lea & Blanchard. 8vo. pp. 227, with 8 copper plates.

Elements of Chemistry, with practical exercises, for the use of schools, by F. J. Grund. 12mo. pp. 301. Carter, Hendee & Co. Boston.

Report on the Geology, Mineralogy, Botany and Zoology of Massachusetts. Made and published by order of the Government of that state: in four parts.—Part I, Economical Geology.—Part II, Topographical Geology.—Part III, Scientific Geology.—Part IV, Catalogues of Animals and Plants. With a descriptive list of the specimens of Rocks and Minerals collected for the Government. Illustrated by numerous wood cuts and an Atlas of Plates. By Edward Hitchcock, Prof. of Chem. and Nat. Hist. in Amherst College. Amherst, Press of J. S. & C. Adams. 8vo. pp. 700.

Memoirs of the American Academy of Arts and Sciences. New Series, Vol. 1., 4to. pp. xxxi, and 595. Cambridge, Printed by Chas. Folsom.

Contents.—Discourse in commemoration of John Adams and Thomas Jefferson; delivered before the American Academy of Arts and Sciences, Oct. 30, 1826. By John Thornton Kirkland, Vice Pres. of the Academy.

I. Remarks on Longevity and the Expectation of Life in the United States, relating more particularly to the State of New Hampshire, with some comparative views in relation to foreign countries, by J. E. Worcester, A. A. S.

II. A Table of the Longitude and Altitude of the Nonagesimal Degree in 42° 23′ 28″ of N. Lat. for every minute of the Right Ascension of the Meridian. With the corrections of the Table for a decrease of 100″ in the Obliquity, and of 1000″ in the Geographical Latitude. By Robert T. Paine, A. A. S.

III. On the Latitude of Boston. By Robert T. Paine, A. A. S.

IV. Tables of the Present Value of a Life-Annuity at any age, according to Dr. Wigglesworth's Bill of Mortality. By J. Ingersoll Bowditch.

V. Occultations and Eclipses, observed at Dorchester, Mass. By W. Cranch Bond.

VI. Observations on the Comparative Rates of Marine Chronometers. By W. Cranch Bond.

VII. Remarks and Inquiries concerning the Birds of Massachusetts. By Thomas Nuttall, A. A. S.

VIII. A Meteorological Journal from the year 1786 to the year 1829, inclusive, by Edward A. Holyoke, M. D., A. A. S. With a prefatory Memoir by Enoch Hale, M. D., A. A. S.

IX. Remarks on the Mineralogy and Geology of Nova Scotia. By Chas. T. Jackson and Francis Alger.

X. Table showing the present value of the Right of Dower of a married woman in any Real Estate, provided she survives her Husband. By J. Ingersoll Bowditch.

XI. Description of a new Stand for a Reflecting Telescope. By Rev. John Prince, L. L. D., A. A. S.

XII. Latitudes and Longitudes of several places in the United States, as determined by Observation. By Robert T. Paine, A. A. S.

XIII. Tables exhibiting the number of White Persons in the United States, at every age, deduced from the last Census, by J. Ingersoll Bowditch.

XIV. Description of a Machine, called a Gypsey, for spinning Hemp and Flax. By Daniel Treadwell, A. A. S.

XV. A Dictionary of the Abnaki Language, in North America; by Father Sebastian Rasles. With an Introductory Memoir and Notes, by John Pickering, A. A. S.

Statutes of the Academy—Fellows—Officers for the year 1833.

Translations, and reprints of Foreign Works.

The Elements of the Differential Calculus, comprehending the general theory of Curve Surfaces, and of Curves of Double Curvature. Intended for the use of Mathematical Students in Schools and Universities. By J. R. Young. Revised and corrected by Michael O'Shannessy, A. M. 8vo. pp. xx, and 255. Philadelphia, Carey, Lea & Blanchard.

The Elements of Analytical Geometry; comprehending the doctrine of the Conic Sections, and the general Theory of Curves and Surfaces of the Second Order. By J. R. Young. Revised and corrected by John D. Williams, Author of "Key to Hutton's Mathematics." 8vo. pp. 288. Philadelphia, Carey, Lea & Blanchard.

Elements of Geometry, by J. R. Young, with additions by M. Eloy, Jr.

An Elementary Treatise on Mechanics. Translated from the French of M. Boucharlat. With additions and emendations, designed to adapt it to the use of the cadets of the U. S. Military Academy. By Edward H. Courtenay, Prof. of Nat. and Exp. Phil. in the Acad. 8vo. pp. 432. New York, J. & J. Harper.

Lamarck's Genera of Shells, with a Catalogue of Species. Translated from the French, by Augustus A. Gould, M. D. 18mo. pp. xiii, and 110. Boston, Allen & Ticknor.

Memoirs of Baron Cuvier. By Mrs. R. Lee (formerly Mrs. T. Ed. Bowditch). New York, J. & J. Harper. 12mo. pp. 197.

An Introduction to Geology: intended to convey a practical knowledge of the Science, and comprising the most important recent discoveries; with explanations of the facts and phenomena which serve to confirm or invalidate various Geological Theories. By Robert Bakewell. Second American, from the Fourth London edition, edited by Prof. B. Silliman. 8vo. pp. xxiv, & 479. New Haven: Hezekiah Howe & Co.

Philosophical Conversations: in which are familiarly explained the causes of many daily occurring natural phenomena. By Frederick C. Bakewell. With notes and questions for Review. By Ebenezer Bailey. 12mo. pp. xii, & 286. Boston: Carter, Hendee & Co.

Astronomy and General Physics considered with reference to Natural Theology. By Rev. Wm. Whewell, M. A., F. R. S., Fellow and Tutor of Trinity College, Cambridge, (being Treatise III. of the Bridgewater Treatises on the Power, Wisdom and Goodness of God as manifested in the Creation.) 12mo. pp. 284. Philadelphia: Carey, Lea & Blanchard.

On the Adaptation of External Nature to the Physical condition of Man, principally with reference to the supply of his wants and the exercise of his intellectual faculties. By John Kidd, M. D., F. R. S., Regius Prof. of Med. in the Univ. of Oxford, (Treatise II. of the Bridgewater Treatises.) 12mo. pp. 280. Phil. Carey, Lea & Blanchard.

The Hand, its mechanism and vital endowments, as evincing design. By Sir Charles Bell, K. G. H., F. R. S., L. & E. (Treatise IV. of the Bridgewater Treatises.) 12mo. pp. 213. Phil. Carey, Lea & Blanchard.

10. *New and valuable illustrations of the Zoology of Brazil.*—Dr. Schreibers, of Vienna, has commenced a work devoted to the description of new zoological objects from Brazil, collected by the scientific *corps* deputed to that country by the Emperor of Austria. It appears that these naturalists, favored by the special protection of Don Pedro, son-in-law to the Emperor, have visited several unexplored districts of Brazil; and as the fruits of their labors, have sent home an immense collection of natural objects, which, on account of its size and interest, has been made to form a new Museum or Cab-

inet, called the "Imperial Brazilian Museum." The proof number received is executed in a superior style, and consists of one sheet folio, and a single plate with colored engravings, contained in a loose envelope. It describes two beautiful species of Humming-bird.

For the benefit of American naturalists and amateurs, we extract the following from the notice contained upon the envelope.

The Editor, Dr. Schreibers, assisted by the collectors, discoverers and curators, of the Imperial Brazilian Museum, proposes to publish the undescribed zoological objects collected in Brazil, in unbound numbers, of the form and manner of execution of the proof number issued; the descriptions to be according to the nature of the objects, in German and Latin, and illustrated by colored and uncolored engravings and lithographs.

In order to diminish the expense to the cultivators of particular departments of zoology, the numbers which contain the objects of each principal division of the animal kingdom, (Mammalia, Aves, Amphibia, Pisces, Insecta, Vermes, after the system of Linnaeus) will be sold by themselves; and if they amount to a sufficient number to constitute a moderate sized volume, they will be bound up as an independent work, and furnished with an appropriate title page.

For the purpose of securing the greater precision and uniformity in the execution of the whole work, the editor has been induced to undertake, and to conduct upon his own responsibility, the edition, both the printing and the engravings; but in consequence of the expense of the enterprise, he finds himself compelled to demand it of the publishers, both domestic and foreign, that they interest themselves in the undertaking; and from them he waits for orders.

The whole impression of each particular number, confined to one hundred and fifty copies, shall, as it is printed, be delivered to the book-trade, who may engage in it, for the amount of expenses incurred by the publisher, which will not amount to more than one hundred and twenty, or one hundred and fifty, at the highest, to two hundred florins, (*C. M. Augsb. Curst.*) provided each number shall contain only one or two sheets of text, and the same number of plates: the book-trade affixing their own price to the same, and incurring the risk of the sale.

The rapidity with which the numbers will appear, must depend upon the patronage of the book-trade. The materials now on hand will allow of the publication of one or two numbers in each department of Zoology, the present year.—Vienna, Sept. 1832. [C.U.S.

11. *Important Work.*—The work on Fossil Organic Remains, by Professor August Goldfuss, M. D., of the Prussian Univ. of Bonn, will be soon translated from the German, by Prof. Gerard Troost, M. D., of the Univ. of Nashville, Tenn.; to which he will add his own Notes on the Organic Remains of Tennessee.

A knowledge of fossil Organic Remains is indispensable to the study of Geology. No country is richer in these remains than the western part of the United States. I collected (says Prof. Troost) large numbers of them during my geological excursions, but found many difficulties in becoming acquainted with my acquisitions. The zoological works in my possession did not afford me much assistance, and I began to despair of surmounting these obstacles, when I became acquainted with the work of Doctor Goldfuss. I read it with delight. I found it an excellent guide, and with it many of my former difficulties vanished. In my leisure moments I commenced a translation of it, at first merely to assist such of the students of our University as had a desire to become intimately acquainted with that part of Natural History; but being in correspondence with its learned author, and accomplished editor, Mr. Arntz, of Dusseldorf, these gentlemen politely engaged to furnish me the original plates, and thus enable me to publish an English translation, if a sufficient number of subscribers could be obtained.

The *Bulletin Universel of M. de Ferrusac*,* says, "The undertaking of Dr. Goldfuss is certainly one of the most interesting contributions that have lately been made to science. Placed at the head of a rich cabinet, having at his disposal the collection of Mr. Hoeninghaus, a zealous and laborious naturalist, Dr. G. had it in his power to make us acquainted with the greatest part of the fossils of a country celebrated for the abundance and interest of the Organic Remains which are found in its formations. The plates and drawings are certainly the best that have been produced in any country, exact in the most minute details, without injuring the harmony of the *ensemble.*

Dr. G.'s figures are all original; not one is borrowed, except to complete a defective specimen. The text, he says, will give only explanations of the figures: he reserves the observations and developments which may interest Zoology and Geology for another time: but the author has done more than he promises.

The text follows the figures of each plate, which are arranged in genera. The name of the genus is followed by a synonym, and by a short characteristic phrase in German and Latin, and geological and geographical notices are subjoined. The first part, which was published in 1826, contains POLYPIFERS: the second part is pronounced by the Bulletin to be the most magnificent work on Natural History that has ever made its appearance in lithography.

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* Paris, 1827; No. 12, page 399.

The plates will be the same in the translation as in the original German publication. The translation of the text will receive the author's latest corrections and additions, several pages of which have already arrived.

As our object (says Dr. Troost) in offering this translation with the original plates, is not gain, but the promotion of science, and to aid our own students in the study of Organic Remains, the price will be about the same as that paid in Germany.

This work will be published in folio, with pica type, on good large medium paper, in numbers, each containing from 100 to 110 pages, with 28 lithographic plates, and an explanatory text, at $8 per number, payable on delivery: there will be four Numbers.

12. *Necrology.*—DIED at Paris, Feb. 6, 1833, PIERRE ANDRE LATREILLE, a zoölogist of great celebrity, and one of the Professors in the Museum of Nat. Hist., at the *Jardin des Plantes.* He was born at Brives, department of Correze, in 1762, and from his youth devoted himself to the study of Natural History. His labors have been chiefly directed to Entomology, in which science he has, for many years, had no superior. Cuvier, who entrusted to him the execution of that part of his *Regne Animal*, which relates to the Crustacea, Arachnides and Insecta, said of him that he had studied insects more profoundly than any man in Europe. Latreille's publications are numerous, and of the highest authority. The earliest of which we have any account, (*Précis des Caractères Génériques des Insectes*, 8vo.) was published in 1796. At the time of his death, he was engaged in the publication of his *Cours* d'Entomologie, the first volume of which appeared in the autumn of 1831.

13. *Mineralogical School at New Haven.*—It having been suggested that the materials, in cabinets, models and instruments, connected with Yale College, render this place peculiarly fit for the exact study of Mineralogy, Mr. CHARLES U. SHEPARD, the present Lecturer on Natural History in the college, offers to afford private instruction to all persons who wish to obtain a knowledge of this science. He will teach it, by lessons and recitations, as a branch of Natural History; and, where it is desired, will instruct in the applications of other sciences to the productions of the mineral kingdom; and also in the applications of mineralogy to mines, metallurgy, and other practical arts connected with mineralogy and geology.

Admission may also be obtained to the lectures on the various branches of Physical Science which are given in Yale College, and to its libraries.

We beg leave to add, on our own responsibility, and without consulting Mr. Shepard, that he is eminently qualified for the undertaking named above. Being a very accurate mineralogist and crystallographer—possessing an excellent and select cabinet of minerals—with habits of great industry—and with much zeal and urbanity—Mr. Shepard renders himself a most useful and acceptable instructor. His friends may add, that his acquaintance with geology, conchology, botany, and entomology, and generally with natural history; with the aid of a very valuable library, and an extensive herbarium, as well as collections in conchology and entomology—presents a combination of advantages rarely united in this country in a single individual.

Such a school as Mr. Shepard would have it in his power to establish, (and which is already begun,) is a great desideratum in the United States.—Ed.

Yale College, New Haven, Jan. 1, 1834.

TO OUR CORRESPONDENTS.

We have to regret the unavoidable exclusion from the present number of many valuable papers and notices; and the acknowledgment of most of the books, memoirs, &c., both foreign and domestic, which we have recently received. This has been occasioned, chiefly, by the occurrence of the meteors of Nov. 13; the historical notices of which could not be postponed, and have occupied more than the space usually allotted to our miscellanies. Most of the latter, including the valuable extracts and translations of Prof. Griscom, we have been compelled to reserve for the next number, when we hope to make, in some measure, amends for present omissions.

We beg leave, however, to remind our friends, that we are not unfrequently placed in circumstances of painful embarrassment, by the uncertainty of our communications, coming as they do from a wide geographical range, at very irregular intervals, and often very late.

Having perhaps (as in the present instance) admitted into the early part of a number,* papers of uncommon length—although it may be of great interest,—we not unfrequently, towards the conclusion, receive, perhaps from unexpected and distant quarters, communications which it is almost equally impossible to admit, or to postpone; and we are driven to the alternative of incurring considerable extra expense which the pecuniary circumstances of the Journal can ill afford, or of causing painful disappointments.

We particularly regret to pass in silence, on the present occasion, the new No. (No. 1. Vol. III.) of Mr. Doughty's Natural History Magazine, interesting as it is in its contents, and beautiful in its execution; the figure of the wild turkey is exceedingly fine, and is rarely equalled in any work.—Ed.

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* We usually begin the printing of a new No. as soon as the one in hand is finished.

INDEX TO VOLUME XXV.

APPENDIX.

*Under the patronage of the Literary and Historical Society of Quebec,**

WILL BE PUBLISHED SHORTLY,

A TABULAR VIEW OF METALLIC MINERALS,

COMPILED FROM THE BEST AND LATEST AUTHORITIES;

COMPRISING A COMPLETE SET OF SYNOPTICAL TABLES,

IN WHICH ALONE

THOSE CHARACTERS MOST OBVIOUS TO THE MERE BEGINNER ARE RENDERED PROMINENT AND MADE TO LEAD HIM, BY AN EASY PATH, TO A KNOWLEDGE OF THE NAME, CHARACTERS, USES, &c. &c.

OF THAT

IMPORTANT CLASS OF MINERAL SUBSTANCES

USUALLY DENOMINATED

METALLIC,

From which the Arts, Sciences, Manufactures and Commerce, derive, directly or indirectly, their greatest aid.

BY FREDERIC H. BADDELEY,

LIEUT. ROYAL ENGINEERS, MEMBER OF THE LITERARY AND HISTORICAL SOCIETY OF QUEBEC, CORRESPONDING MEMBER OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

"On peut etre utile sans eteindre a la perfection."—*Saussure.*

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* To this Society, the above work was originally presented, and had the honor to experience a most flattering reception, having been ordered to be published in its Transactions, but as it did not meet the views of that body to publish immediately, and the Compiler was, for obvious reasons, desirous of doing so; permission, couched in the most complimentary terms, was given by the Council, to withdraw the paper and publish it under the Society's auspices.

The first impressions of this work will be published by subscription, and all monies received on its account, over and above the cost of publishing it, will be appropriated towards the support of the Orphan's Asylum of Quebec. This is not intended as a parade of philanthropy; its object being rather to promote the circulation of the work, (and perhaps to secure it from severe criticism,) than to cover its author

Tabular View of Metallic Minerals.

The object of this compilation is to facilitate the progress of the student in Mineralogy, by affording him the ready means of ascertaining the name, &c. of a given mineral, coming under one or more of the general definitions of the metallic class. The grand divisions, subdivisons, sections, &c. upon which it is founded, are limited by such obvious and striking characters, that they cannot pass unnoticed by him who enjoys the full use of his eyes and his nostrils, provided only he will make the simple but necessary experiments to develop them.

It is not pretended that there is any thing novel, generally considered, in the work which is about to be offered to the public; the details of its arrangement, however, will be found to differ in many respects from any before published on the same subject, and I need not add, that in my own opinion, at least, they differ on the side of improvement; an opinion which it is anxiously hoped the reader will also entertain when the plan and tables shall develop themselves.

From a work, entitled "A Practical Treatise on the Use of the Blowpipe, by John Griffin,"* I have borrowed the idea of the following arrangement, and have closely followed its author in giving prominence to the characters of volatility, hardness and specific gravity. I have, indeed, endeavored to make the first character more definitive than he has done, with what success, he and other experienced mineralogists must decide, as well as upon the utility of the whole compilation.

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with the mantle of charity. Wishing to see my labors rendered available, and knowing that my own name would conduce little towards that object, I have associated with both, an agent much more powerful than either; not that I mean to disclaim all interest in the state of the funds of so noble an institution, but only that their increase was in the least degree my motive for writing. This I say to secure me from future misconstruction or misrepresentation, and for the same reason the names of subscribers will be published, together with a debtor and creditor account, drawn up between all parties concerned.

* This clever little book should be in the hands of every mineralogist who admires conciseness, perspicuity, order, portability and cheapness: its mineralogical classification is after Aikins' System, published in 1815.

The works which have been studied, more particularly, in forming these tables, are alphabetically the following: Berzelius, (Children's translation,) Cleaveland, (second edition,) Griffin, Jameson, (third edition and Manual,) Mohs, (Haidinger's translation, 1825,) Phillips, (third edition,) and Shepard,* and not one of the prominent characters made use of in them has been assigned to a mineral, until reference has been made to most of these authorities, excepting only the first and last; the former being authority alone for some of the pyrognostic characters, while the latter never describes any which are chemical, reserving them for his second volume; so that if this attempt should prove a failure, it will not arise from want of industry on the part of the Compiler, whose original object in the undertaking, self improvement, will have been attained, whatever opinion may be ultimately expressed of the result of his labors. In the mean time, it must be confessed, (his only excuse for offering them to the public,) that the Compiler is not without the hope, that while, as tables of reference, they will be consulted more readily than any before published, they will, at the same time, rarely disappoint the individual who may consult them, as long, at least, as his enquiry is directed to metallic minerals, which have been fully described.

Before I conclude this introductory portion of my essay, it may be proper to remind the reader that the forthcoming tables are intended to facilitate an effectual reference to systems of

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* This young and promising naturalist and chemist, has recently (1832) put forth the first volume of a Treatise on Mineralogy, in which a tabular form similar to the one here made use of, is, I think, for the first time adopted. In it, whenever possible, (contrary to the plan pursued in this arrangement,) the crystallographic character has been made the characteristic or most prominent feature; a more scientific method certainly, but one less accessible to the generality of students than that founded on the more obvious characters derived from the use of the blowpipe, particularly as regards metallic minerals. In the study of mineralogy we should never lose sight of its principal object, viz. to ascertain either what a mineral is or what it is not, and the readiest means to effect this should be employed, whether scientific or empirical. But if we are often to look for almost invisible cleavages, or to measure nearly microscopic angles, with instruments unmanageable by common hands, in order to deduce primary forms by perplexing observations or calculations, the arena of the science will be closed against all except professors and their assistants.

mineralogy, not to supply their place, and therefore it is presumed, that in consulting the former he will always bring with him some previous knowledge of the subject, at least, as regards vocabulary and manipulation, as he is not to expect, in the present attempt, any explanation of either of these necessary adjuncts; in making which, however, the Compiler has endeavored to render this preliminary knowledge a minimum, by giving prominency only to the most obvious characters. F. H. B.

EXPLANATION OF THE PLAN OF ARRANGEMENT.

First Grand Division.

It is the character of many of the metallic minerals to hold, among their constituents, volatile bodies, which, exposed to a certain temperature, within the reach of the blowpipe, pass off under the form of a vapor, usually both visible and odoriferous; often condensing upon the support, (charcoal,) as a yellowish, brownish, reddish, bluish or whitish powder. This is so constant a characteristic of several metallic minerals, and at the same time one so obvious to the senses, that its development or non-development, under the action of the blowpipe, may be well made portions of the grand frontiers of introduction and exclusion among them; and accordingly, while volatility, with fusibility, or perfect volatility alone, is made to limit the first grand division, the want of volatility, with fusibility, limits the second.

The first grand division is separated into two divisions, the distinguishing feature of which is still one of volatility, viz. the development, or not, of an arsenical odor before the blowpipe.*

* The blowpipe has sometimes been described as a difficult instrument to use; whereas, for all common purposes of roasting and reduction, it is very easy. The directions which are usually given, to contract and distend alternately the muscles of the face, at the same time breathing through the nose, are unnecessary and occasion a number of useless grimaces. If so unexperienced a practitioner might presume to give a word of advice, it would be, to persevere in blowing steadily and moderately, with the endeavor always to preserve, as long as possible, a well defined flame, a cone within a cone, the innermost being blue: repeat this a few times, and the rest will soon follow.

It is upon no less authority than that of Berzelius, that such prominence has been given in the tables to these characters. He says, (page 122 of his work on the Blowpipe,) "The odor of arsenic is so good a character, that it (the arsenic) may even be detected by it (the addition of a little soda) in the small portion of smalt commonly used to give a blue tinge to paper." Now arsenic forms a constituent among a large portion of the volatilizable metallic minerals. An objection may be urged against the use of such a character, upon the grounds of the poisonous nature of the metal, but the same writer, after warning his reader against unnecessary exposure to its vapors, adds, "I confess, however, that I have often been in chambers, the air of which was loaded with the smell of arsenic, without having ever experienced any ill consequences, and I have been astonished at seeing the workmen at the silver foundries near Freyberg, daily immersed in an arsenical atmosphere, without their health appearing to be injured by it." *The strongest argument which can be urged in favor of its employment, as a character, arises out of the* NECESSITY *which exists of noticing the arsenical odor in submitting minerals to the blowpipe, if that metal be present in the assay.*

As our enquiry is confined to the existence of vapor which is sensible either to the sight or smell, when the assay (the source of it) is submitted to heat, I shall say nothing of the means to be adopted to render it evident, when, without additional experiment, it is not so, as this information is not necessary here, and may be met with in the fullest detail in works which treat on such subjects, particularly in that from which two quotations have just been made, and in Griffin's portable volume before mentioned. However, no mineral must suffer exclusion from the first grand division, until it has been exposed to heat in the tube, roasted on charcoal in the oxidating flame of the blowpipe, and submitted to the utmost heat in the reducing flame, in all of which cases the nose should be brought near the assay, while in a state of ignition. The presence of volatile matter will also be often indicated by the odor it imparts to the charcoal while it is subliming.

The first division is again parted into subdivisions depending upon the presence or not of metallic lustre. Some innovation having been here made upon the established practice, as regards the application of these characters for purposes of distinction, I am bound to give a reason for it. Certain minerals in the metallic class possess a lustre which is intermediate between metallic and non-metallic; these have hitherto, generally speaking, been ranked with metallic minerals, which *want* the metallic lustre, but there exists quite as much reason to arrange them with those which possess it, for the fact is that they are often not to be distinguished from them by this character alone. Moreover, one eye often considers that to be metallic lustre which another declares is not, and that in spite of the test of the streak, which, however good, is not infallible. Influenced by this reasoning, those minerals which are described as possessing the imperfect or semi-metallic lustre have been introduced, throughout these tables, under both heads, "lustre metallic," "lustre not metallic." This will, undoubtedly, occasion repetition, but the student will be benefited by it, as it will save him the trouble of referring, backwards and forwards, from one table to another. It has always appeared to us, that a tabular view should embrace all probable and even possible cases, as well as positive, and we have endeavored throughout this, to conform to that opinion.

The subdivisions in this grand division, where necessary, are divided into sections, depending upon hardness; these require no comment farther than to remind the reader that they blend one into the other, by which observation it is intended to convey to him the hint, that if he fails to find the mineral he is in search of, under one section, he will probably meet with it in the next; and this remark applies to the character of hardness throughout these tables.

In those sections in which the minerals are numerous, sub-sections are introduced: thus, in tables 9, 10, 11, 12, there are sub-sections; 9 and 10 are made to depend upon the development or not of the odor of selenium (like putrid horse-radish) before the blowpipe; 11 and 12 upon specific gravity. As in the instance of arsenical odor, Berzelius is again my authority for giving prominence to the former set of characters; he says, (page 120,) under the head "metallic seleniurets," "These are more readily known than any of the other metallic compounds of the same order, by the odor they emit when heated in the exterior flame, the better to distinguish which the assay must be applied to the nostrils whilst hot. This odor is very strong and very disagreeable, and resembles that of decayed horse-radish: the smallest portion of selenium may be detected by it."

With regard to specific gravity, it is to be observed that, besides making it occasionally a sectional or sub-sectional distinction, the minerals throughout the tables are arranged, as near as possible, in the order of their specific gravity.

Second Grand Division.

All metallic minerals which fuse, partially or wholly, in the flame of the blowpipe, without developing either to the sight or smell the character of volatility, are included under this head.

In this grand division there are, as in the first, two divisions, but the presence or not of metallic lustre is there the distinguishing feature.

The subdivisions are regulated by sp. gr. in one instance—by hardness in the other—the sections necessary, by specific gravity.

Third Grand Division.

This grand division contains those metallic minerals which are almost or altogether, infusible in the flame in the blow-pipe. It embraces the greater portion of the iron ores, a numerous class easily recognised, for the principal part, by being magnetic, or by becoming so, after roasting on charcoal; a property which is here employed to distinguish the first from the second division of this grand division.

The subdivisions are "Lustre metallic," "Lustre not metallic." The Sectional divisions are founded on hardness, and where subsections are necessary they are regulated by specific gravity.

Fourth Grand Division.

Herein are arranged the metallic salts as well as other metallic minerals which may be soluble in water, (as oxide of arsenic, which however appears also in the first grand division) they are distinguished from the metallic minerals, or ores properly so called, by their solubility in water, and from earthy salts in general, by the styptic metallic flavor which they impart to the palate. They are, obviously, too few to require division, being readily distinguished from one another by their chemical characters.

Appendix.

All those metallic minerals, whose characters are not sufficiently known to admit of being introduced with confidence into one of the foregoing tables are entered here.

General Observations upon these Tables.

The object held constantly in view, in forming these tables, has been to prevent, as far as the compiler has found it possible to do so, the individual who may consult them, from experiencing disappointment. To effect which the former has found it necessary, in consequence of the sometimes doubtful or contradictory information which the systems of mineralogy* consulted, afford, to re-

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* The individual who shall study the different systems in Mineralogy which are extant, even in his own language, will be struck, occasionally, by the contradictions which occur in the descriptions given of the same mineral by contemporary writers, and every successor flatters himself that he has corrected the *apparent* errors of his predecessor. I say apparent because there is full as much reason to suppose that the difference in descriptions arises out of a real difference in the specimens examined, as that any error exists in the observations of distinguished mineralogists, and indeed these very contradictions are often a proof that such are not the labors of a mere compiler like myself. With this impression we thought it advisable to make these tables embrace all discrepances met with in the works consulted. There is less risk of error by adopting this plan, than in neglecting it, for should it ever happen, as is possible that a given mineral will in consequence sometimes be out of its place, it will be associated with others, the difference in whose characters, will sufficiently distinguish them. The necessity of adopting a similar arrangement as regards the fusibility or infusibility of minerals, is very apparent ; because it cannot be supposed that all operators with the blow-pipe will produce the same effect on the same mineral. It is easy to conceive, for instance, that Berzelius would in some instances, describe that body as fusible, which another, less practised than himself, would consider infusible. A difference in the results also arises from the form and size of the assay, and from the kind of blow-pipe made use of, particularly as regards the size of its bore. These considerations have induced the compiler to insert under the grand division of infusible, even those minerals which are described as difficultly or only partially fusible, and *vice versa.*

peat under different headings the same mineral, in order to suit such uncertain descriptions, as it is manifestly out of the power of the compiler to distinguish that which is most correct; besides, it is more probable that any similar discordance arises in a real difference between two or more given specimens of the same mineral, than that any error exists in description.

Analogous reasoning has induced him, as before said, contrary to custom, to introduce those metallic minerals which have an imperfect or semi-metallic lustre, under both divisions, "lustre metallic," "lustre not metallic," as the distinction between those minerals in the intermediate stage and those positively of metallic or not metallic lustre, is, as regards those characters, often evanescent and inappreciable, a fact which is in harmony with the present received opinion that earths are metallic oxides, and metals deoxygenated earths ; the distinction which arises from the presence of the true or semi metallic lustre has not, however, been lost sight of.

In the construction of tables of this description there is more risk of failure by attempting to be too definitive or exclusive,* than the contrary. Assume in mineralogy what arrangement you please, a neutral ground will always exist more or less on the divisional frontier, which is moreover, better represented by a broad band, whose colors imperceptibly blend, than by a line. Agreeably to these views, the characters of hardness and specific gravity have been expanded, as it were, so as to embrace all the respectable authorities consulted.

When the doubt originates in the compiler's inexperience, the same plan has been followed, as it will probably happen that

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* To be *usefully* exclusive, a characteristic should be made, to include all respectable statements, as the attempt to be too definite by being too partial, may occasion a given mineral to be omitted altogether, or occasion its introduction *only* under an inappropriate heading. Also the attempt to contract too much by decimation those two important characters, specific gravity, and hardness, narrows the sphere of their usefulness, by introducing into descriptions a precision which probably does not exist in nature, or if it does, cannot be taken advantage of by the generality of students owing partly to their own want of skill, but more to the varying nature of the evidence they consult. The crystallographic character is perhaps the only one which will admit of such nice distinctions, but its abstruseness and comparative infrequency of occurrence are unfavorable to its being employed as a characteristic.

other students, in their early efforts, will meet with similar difficulties. In short, whenever any doubt has arisen, from whatever cause, having relation to any of the prominent characters employed in tbese tables, as fusibility, volatility, hardness, specific gravity, and magnetism, the mineral which is the subject of it, has been repeated to meet all views; a plan which removes the risk which might otherwise exist of its being omitted in its proper place.

It is to be hoped that these tables will not suffer condemnation if they should not always conduct the student to a right conclusion, for, owing partly to the uncertain nature of the science itself, partly to the constant discovery of new minerals, and partly to the difficulty or rather impossibility of drawing an artificial distinction, where perhaps no natural one exists, (to say nothing of the compiler's incompetency, which cannot of course be urged in mitigating critical censure,) it is impossible to provide against disappointment in all cases. He must not however conclude that his mineral has been omitted, because a first attempt to identify it should fail. On the contrary, when such a disappointment occurs, recourse must be had to the sub-division or section, &c. whose characteristic is next nearest in apparent agreement. It may rarely indeed happen that reference must be had to even a different grand division to the one the mineral seems to belong to, as in the instance of an unobserved though existing volatility the specimen being fusible, in which case it is obvious that failing to find it described in the second grand division, it must be sought for in the first. It is evident also that in all attempts of this nature, to be useful, something must be left to the discretion and judgment of the student, to whom I offer the two following closing hints. 1st. It is in mineralogy as in navigation; he who steers for a certain port, must not expect that all his nautical observations on the voyage will precisely agree with those of the individual who has preceded him; an approximation in the main features of the journals is all that is required, and all that probably will be found. 2nd. If in consulting these tables, he finds himself embarrassed, he is requested to seek a solution of his difficulty, by giving greater prominency to the subordinate characteristics.

Metallic Minerals defined.

Minerals are metallic when

1. The Specific Gravity exceeds 5.0.
2. The streak, or scraped surface exhibits metallic lustre.
3. They can be reduced to the metallic state, on charcoal, by the flame of a blow-pipe, with or without borax.
4. They possess ductility or malleability, with high specific gravity.
5. They exhibit the hackly fracture.
6. The color they communicate to borax before the blow-pipe is a vivid green which does not vanish on cooling, a smalt or sky blue, a hyacinth red, violet blue, or amethystine.
7. They are volatilized entirely before the blow-pipe, the specific gravity being above 2.5.
8. They are volatilized in part, exhaling the odor of arsenic, or antimony, or selenium, or tellurium.
9. They are magnetic, either before or after roasting on charcoal, the specific gravity being above 4.5.
10. When they impart a styptic metallic flavor to the palate.

Minerals are *probably* metallic when

1. The specific gravity exceeds 4.0.—The exceptions are given, sapphire (green), automolite, gadolenite, some varieties of the garnet, with sulphate and carbonate of barytes.
2. When they communicate any color to borax before the blow-pipe. The exceptions, however, are many, as garnet, hornblende, actynolite, augite, hyperstene, chlorite, lava, pumice, basalt, cinnamon stone, idocrase, common schorl, hauyne, colophonite, boracite, &c. &c. in all of which some metallic oxide, usually of iron, affords the coloring principle.
3. They are volatilized entirely or almost entirely before the blow-pipe. The exceptions are confined to the combustible and saline classes, as sulphur, coal, muriate of ammonia, &c.
4. They exhibit the semi or imperfect metallic lustre. The exceptions are mica, talc, hyperstene, anthophyllite, aphsite, bronzite, sometimes schiller spar, and olivine.
5. They exhibit magnetism, either before or after roasting on charcoal—the exceptions are sometimes basalt, lava, pumice, hornblende, garnet, &c. also some rocks or portions of them.

6. They are found coating or investing other ores, either as a crust or powder.

SYNOPSIS.

First Grand Division.—Tabular view of metallic minerals which fuse or volatilize entirely in the flame of a blow-pipe, exhaling visible or odoriferous vapors of arsenic or antimony or sulphur, or any other peculiar vapors which have been noticed by mineralogical writers. (Tables from 1 to 14.)

Second Grand Division.—Tabular view of metallic minerals which fuse partially or wholly in the flame of the blow-pipe, without developing any volatility either to the sight or smell. (Tables from 15 to 20.)

Third Grand Division.—Tabular view of metallic minerals which are almost or altogether infusible in the flame of the blow-pipe. (Tables from 21 to 31.)

Fourth Grand Division.—Tabular view of metallic minerals which impart a styptic metallic flavor to the palate and are soluble in water. (Table 32.)

Appendix.—Tabular view of metallic minerals whose characters are not sufficiently known to admit of confident arrangement in any of the foregoing tables.

FIRST GRAND DIVISION.

First Division.—Exhale the arsenical odor, before the blow-pipe.—(Tables from 1 to 6.)

First Sub-division.—Lustre metallic, (including semi or imperfect metallic.)

1*st Sectoin.*—(Table 1.)—Always scratched by quartz, often scratched by felspar, sometimes scratched by apatite, never scratched by fluor.

2*d. Section.*—(Table 2.)—Always scratched by felspar, often scratched by apatite, sometimes scratched by fluor never scratched by calc. spar.

3*d. Section.*—(Table 3.)—Always scratched by calc. spar.

Second Sub-division.—Lustre not metallic, (including semi or imperfect metallic.)

1*st. Section.*—(Table 4.)—Always scratched by apatite, often scratched by fluor, sometimes scratched by calc. spar, never scratched by gypsum.

2*d. Section.*—(Table 5.)—Always scratched by fluor, often scratched by calc. spar, sometimes scratched by gypsum, rarely scratched by talc.

3*d. Section.*—(Table 6.)—Always scratched by calc. spar, often scratched by gypsum, sometimes scratched by talc.

Second Division.—Exhale no arsenical odor before the blow-pipe.—(Tables from 7 to 14.)

First Sub-division.—Lustre metallic, (including semi or imperfect metallic.)

1*st. Section.*—(Table 7.)—Always scratched by quartz, often scratched by felspar, sometimes scratched by apatite, never scratched by fluor.

2*d. Section.*—(Table 8.)—Always scratched by felspar, often scratched by apatite, sometimes scratched by fluor, never scratched by calc. spar.

3*d. Section.*—(Tables 9 and 10.)—Always scratched by felspar, often scratched by calc. spar, sometimes scratched by gypsum, rarely scratched by talc, one instance of semi-fluid softness.

1*st. Sub-section.*—Exhale an odor like putrid horse-radish, before the blow-pipe.

2*d. Sub-section.*—Exhale no odor like putrid horse-radish, before the blow-pipe.

4*th. Section.*—(Tables 11 and 12.)—Always scratched by calc. spar, often scratched by gypsum, sometimes scratched by talc, one instance of fluid softness.

1*st. Sub-division.*—Sp. gr. never below 6.5.

2*d. Sub-division.*—Sp. gr. never above 7.2.

Second Sub-division.—Lustre not metallic, (including semi or imperfect metallic.)

1*st. Section.*—(Table 13.)

2*d. Section.*—(Table 14.)—Always scratched by apatite, often scratched by gypsum.

SECOND GRAND DIVISION.

First Division.—Lustre metallic, (including semi or imperfect metallic, (Tables from 15 to 20.)

1*st.* *Sub-division.*—(Table 15.)—Sp. gr. never below 4.0.

2*d.* *Sub-division.*—(Table 16.)—Sp. gr. never above 5.0

Second Division.—Lustre not metallic, (including semi or imperfect metallic.) Tables from

1*st.* *Sub-division.*—(Table 17 and 18.)—Always scratched by quartz, often scratched by felspar, sometimes by apatite, never scratched by calc. spar.

1*st.* *Section.*—Sp. gr. never below 3.5.

2*d.* *Section.*—Sp. gr. never above 4.0.

2*d.* *Sub-division.*—(Tables 19 and 20.)—Always scratched by fluor, often scratched by calc. spar, sometimes scratched by gypsum.

1*st.* *Section.*—Sp. gr. never below 5.0.

2*d.* *Section.*—Sp. gr. never above 4.0.

THIRD GRAND DIVISION.

First Division.—Magnetic either before or after roasting on charcoal. Tables from

First Sub-division.—Lustre metallic, (including semi or imperfect metallic.)

1*st.* *Section.*—(Table 21.)—Always scratched by quartz, often scratched by felspar, sometimes scratched by apatite, never scratched by fluor.

2*d.* *Section.*—(Table 22.)—Always scratched by apatite, often scratched by fluor, sometimes scratched by calc. spar, rarely scratched by gypsum.

Second Sub-division.—Lustre not metallic, (including semi or imperfect metallic.)

1*st.* *Section.*—(Table 23.)—Always scratched by quartz, often scratched by felspar, sometimes scratched by apatite, never scratched by fluor.

2*d.* *Section.*—(Table 24.)—Always scratched by apatite, often scratched by fluor, sometimes scratched by calc. spar, rarely scratched by gypsum.

3*d.* *Section.*—(Table 25.)—Always scratched by calc. spar, often scratched by gypsum.

Second Division.—Not magnetic, either before or after roasting on charcoal. Tables from

First Sub-division.—Lustre metallic, (including semi or imperfect metallic.)

1*st. Section.*—(Table 26.)—Always scratched by quartz, often scratched by felspar, never scratched by apatite.

2*d. Section.*—(Table 27.)—Always scratched by apatite, often scratched by calc. spar, sometimes scratched by gypsum.

Second Sub-division.—Lustre not metallic, (including semi or imperfect metallic.

1*st. Section.*—(Tables 28 and 29.) always scratched by quartz, often scratched by felspar, sometimes scratched by apatite, never scratched by fluor.

1*st. Sub-section.*—Sp. gr. never below 4.5.

2*d. Sub-section.*—Sp. gr. never above 5.0.

2*d. Section.*—(Tables 30 and 31.)—Always scratched by felspar, usually scratched by apatite, often scratched by calc. spar, sometimes scratched by gypsum.

1*st. Sub-section.*—Sp. gr. never below 3.5.

2*d Sub-section.*—Sp. gr. never above 4.0.

FOURTH GRAND DIVISION. (Table 32.)

No Divisions, Sub-divisions, nor sections.

APPENDIX.

No arrangement yet fixed upon.

Directions for using the Tables.

Having ascertained by reference to the page in which metallic minerals are defined, that the mineral whose name, &c. he is in quest of is metallic, the student will at the same time determine whether it be soluble in water or not. If soluble, it of course belongs to the fourth grand division, and nothing further is required than to compare it with the few minerals which compose the 32d table. If insoluble, as it most probably will be, he must make experiments with the blow-pipe in order to determine

1st. Whether the mineral in question be either entirely volatilizable, or fusible with visible or odoriferous volatility.

2d. Or whether fusible without the appearance of volatility,

3d. Or whether infusible.

In other words whether it belongs to the first, second or third grand divisions. Supposing the mineral to belong to the first grand division, the experiment* which determined that it did, will also have determined whether any arsenical odor is developed or not, by which the division is ascertained—next follows an inquiry into the kind of lustre, for sub-division—then hardness, for section, &c. &c. But it is quite unnecessary to proceed further in the way of explanation, as an inspection of the synopsis and tables will afford the student all the information requisite, provided he has already made a *little*, *a very little*, progress in the science; for the individual who has not, these tables were not compiled.

Form of Table.

No.	Name of Mineral.	Form under which it usually occurs.	Sp. gr.	Hardness and Frangibility.	Color.	Streak or powder.	Lustre.	Structure or Fracture.	Effect of the blow pipe, on charcoal.	Additional characters.	Geological situation, associations, and remarks.
	Usually from Phillips contains also references by page to Phillips, Mohs, and Cleaveland.	Usually from Phillips.	Between 4.0—5.0. Includes all authorities consulted.	Between felspar and fluor, includes all authorities consulted. Brittle, from Philips or Cleaveland.	Usually from Philips.	Streak from Mohs. Powder from Phillips or Cleaveland.	Usually from Jameson.	Usually from Phillips or Cleaveland.	Usually from Berzelius, Griffin, or Mohs.	Passage of light, &c. Effect of acids or alkalies.	With uses, and nature of components.

The foregoing preamble to the tables it is proposed to publish is, through the politeness of Prof. Silliman, now published in an appendix to his Journal, with the *hope* of drawing from liberal criticism such comments as may help our subscription list, previously to publication, and the sale of the book afterwards. The terms have already been made public—they are here repeated. Subscribers to the amount of 1£ currency, will be entitled to receive four copies, two copies 12*s*. 6*d*.—single copy 7*s*. 6*d*. It will be printed with good type, and paper, in a neat demi quarto form, half bound in sheep, and will consist of upwards of thirty two distinct tables, exhibiting under appropriate headings, the external, chemical, and geological characters, of the minerals entered in them, together with the preamble, and probably an index. Individuals wishing to subscribe, are requested to intimate that wish by letter *(post paid)*, addressed to the compiler.

* The same experiment will inform him whether selenium be present or not, which is also well ascertained by an odor like that of putrid horse radish, which this metal exhales when exposed to heat, and this will be ascertaining *indirectly* whether or not this mineral belongs to either tables 9 or 10. I say indirectly because for the sake of uniformity this distinction is made subsectional in these tables.

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PHILADELPHIA

POPULAR **MEDICINES**

Quinine

Carpenter's compound fluid ext. of Sarsaparilla for extemporaneously making Lisbon diet drk.

Piperine.

Carpenter's compound fluid Ext. of Buchu, Diosma Crenata, a valuable medicine, for diseases of the bladder, Chronic Gonnorrhea &c.

Iodine.

Carpenter's ol. Cantharid. for producing speedy & certain vesication by simply rubbing the part.

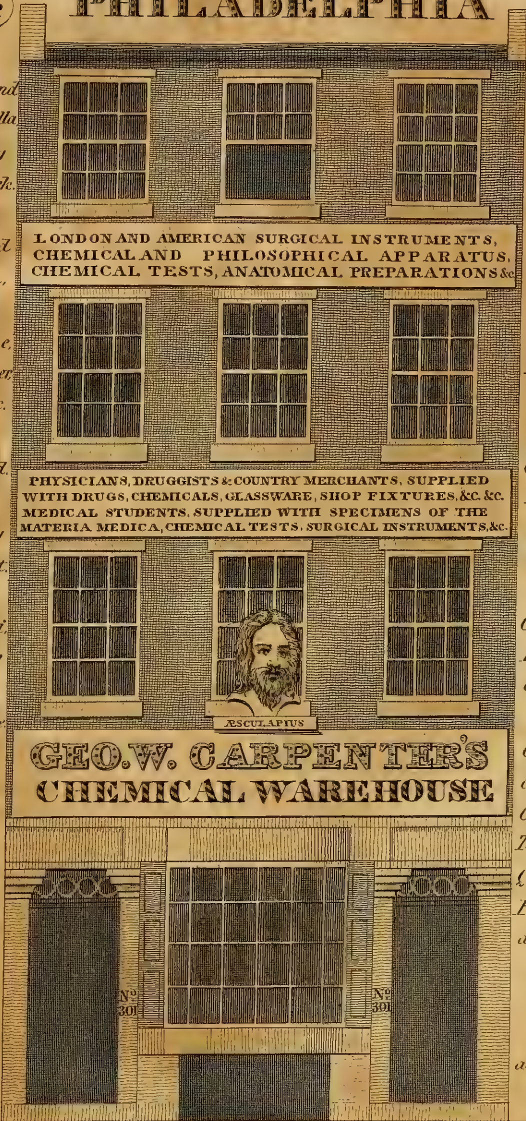
Cornine.

Carpenter's citrated Kali, for extemporaneously making the saline, draught or neutral mixture.

Brucine.

Veratrine, Croton oil, Oil of Copaiva, Carpenter's Chalybeate Ginger Powders, a valuable remedy, in Dispepsia & Indigestion. Oil of Euphorbia, Ioduret of Mercury, Chloride of Soda, Blk. oxide of Mercury.

Prussic Acid.



Morphine.

Carpenter's Saratoga Powders, for making Congress Spring, or Saratoga Water.

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Carpenter's compound Syrup of Liverwort, Hepatica Triloba, a safe & valuable remedy, in hepatic and Pulmonary affections.

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CARPENTER'S
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It is an object of the highest importance for a physician, to obtain medicines, upon whose genuineness and purity he can always rely, and which are uninjured by age or exposure.

It is unnecessary to point out the serious disadvantages which practitioners of medicine labor under, in the administration of feeble or inert preparations. Their skill and judgment are sacrificed; their talents and experience, although they may be of the highest order, are brought down to the level of the least intelligent of the profession; nay more, they are often rendered unsuccessful in the treatment of cases which would have speedily yielded to the salutary influences of pure medicines.

Philadelphia has long been justly celebrated for the talents and skill of her medical men, as well as for the scientific and practical knowledge of her druggists and apothecaries. The standard medical works annually produced by the distinguished professors of her medical colleges and by her private medical gentlemen, together with her eminent medical journals are decisive proofs of the truth of these remarks.

With these things premised, I beg leave so far to deviate from custom, as to exhibit a correct description of my new pharmaceutical and vending establishment, and of the facilities with which I am enabled to supply the orders of medical men from all sections of the United States.

I have erected, on the ruins of my old stand, (lately destroyed by fire,) a large and commodious four story warehouse, as represented in the annexed plate, and also, in rear of the same lot, a laboratory for the manufacture of the vegetable extracts, proximate principles and finer chemical products. The store has been erected, exclusively, for the object of the drug and chemical business, and in its construction, every convenience has been faithfully studied and executed for this object alone.

The retail department of the store is distinct, in order that the wholesale business may not interfere at all with it, but that both can be conducted on the most extensive scale, without the one interfering with the other. Thirteen persons are employed in preparing, compounding and packing medicines. The retail department is conducted by the six most experienced of the number, who, in weekly rotation, give their entire attention to this department, and in this way an intimate knowledge of both branches can easily be acquired. The acting head of this department attends to receiving all goods, and the examination of bills; he acts, moreover, as treasurer in receiving and paying out monies, of which he files a daily account.

The first floor of the store is appropriated, in part, to the retail business, and contains two hundred mahogany drawers, five hundred bottles, from two gallons to a quart, one hundred porcelain jars, and thirty show cases with plate glass, all of which are neatly labelled in gold, and appropriated, exclusively, to the retail department. The depth of this part of the store is thirty feet, and it contains four counters, on which are two pair of silver scales and two of brass. The ceiling is thirteen feet six inches high, for the distance of thirty feet; it then falls to nine feet, shewing an opening, in the centre of the store, of four feet six inches, finished with railings, &c., in the center of which is one of Lukens' superior regulated time pieces, decorated on each side with two dolphins, with a wreath of flowers in the center, on which is the hive of industry, all of which is tastefully carved in wood and bronzed with gold, and moralized by the motto, *Tempus fugit*. The whole, being executed with a rich and ornamental finish, produces a pleasing effect on entering the store.

From this point, but still on the first floor, commences the wholesale department, which extends further in depth, thirty five feet, making the whole uninterrupted depth of the store sixty five feet in the clear. In this department is a further continuation of drawers of larger size, a hatchway, stairs, &c.; also a counter twenty feet long and four feet wide, on which are a large pair of brass scales. These scales, as also those previously described, are manufactured by Mr. John Wilbank of this city. The workmanship and construction of these scales are very superior; they should be in the possession of every druggist and physician, who wishes a superior, neat and durable article, which will weigh with exactness. They are easily kept in fine order, and cannot fail in a short time to supersede the worthless articles which have for so long a period worried and perplexed those who were exact in weighing, as every man should be under all circumstances, but, especially in a business involving health, and even life. On the west side of the walls, commence the anatomical cases, containing specimens of the various preparations for the use of the student, as wired skeletons, loose bones, arterial, venous and lymphatic preparations, articulated heads, female pelvis and fœtal heads, and various isolated preparations of the human body, &c. neatly arranged for exhibition. This is followed by cases of the various kinds of surgical instruments, of London and American manufacture. The American instruments are now made of very superior quality, and I think can be depended upon as equal to the London, with the exception of those manufactured by the justly celebrated Evans, which I believe are unequalled any where. Immediately following this range of cases, is a distinctly legible inscription, in gold, on a black ground, of the rules and regulations of the establishment. This is a valuable arrangement in all stores, or places of every kind, where a number of persons are engaged, and where the duties and requisitions are of a diversified nature. The next thing in succession is a medical library for the use of the store, which is followed by a set of tubes or speaking trumpets, communicating with each story of the building, by which sound is readily conveyed; a corresponding number of bells follows, to call attention to the trumpets when required. In this way, where a large business is done, much time is saved and a great facility given to the transactions. Any question can be made to those in the fourth story without any great exertion of voice, and an answer conveyed with corresponding facility. Then follows in rotation a fire-proof of large size and new construction, the draft of which was furnished by Mr. Wilbank. Of the expediency of this arrangement, sad experience has demonstrated the utility, and no man should build a store without the most scrupulous attention to a fire-proof for the safety and security of his books and valuable papers. The construction of this fire-proof is new, and presents several advantages which are not found in any other which I have seen. It has two sets of double doors; it opens four feet wide and six feet high, and inside is lined all around with iron: the weight of the iron work is one thousand five hundred pounds. Counting house desks, grates, hydrant, &c. finish the first floor of the building.

The second story is a continuation of drawers and bottles, alphabetically arranged, like the first floor, and contains four hundred drawers and eight hundred bottles of various sizes, labelled in gold; also, counters and scales, &c.

The third story contains packages of goods, opened and placed in bins, holding each about a barrel and a half, which are arranged in regular rows, six rows in number, and each row extending in depth forty five feet; also counters and scales, as in the other stories. In this story is also partitioned off a mineralogical room, centaining a cabinet of near four thousand specimens, neatly arranged, besides a large duplicate collection for exchanging.

The fourth story contains glass ware of various descriptions, unpacked on shelves running the whole length of the store, sixty five feet; also packages of goods unopened, arranged in regular rows, with sufficient space between to admit a person to walk; also a loft for hay, boxes, &c. and an improved hoisting machine, by which the orders put up, on the first floor are raised and packed, and again let down when ready to ship or send away. In consequeuce of a want of room being still experienced, it is intended shortly to add another story to the building.

This finishes a brief outline of the construction of my store, and I hope I shall be indulged to say in conclusion, that I give a devoted personal attention to business, and no article is received into or sent away from the store without my particular examination, and no article of inferior quality is ever received or sold. I have adapted all my plans and arrangements for supplying the orders of *physicians* and *medical men.* As I keep no paints, oils, varnishes, dye-stuffs, &c., I can therefore attend more especially to the calls and wants of practitioners of medicine, and all my pharmaceutical and finer chemical preparations being made in my own laboratory and store, I can, of course vouch for their purity and for the mode by which they are prepared. I therefore invite, from all parts of the United States, the orders of the faculty, and also of country druggists and merchants, who are particular about the quality of their medicines.

If any orders, from merchants or druggists at a distance, for paints, oils and dye-stuffs, are included, I can have these articles furnished, at the lowest rate, availing myself, for that purpose, of the aid of an experienced agent.

It is my intention to keep a very extensive assortment of articles, embracing every thing connected with the profession, so that orders for all articles can be readily executed, and goods can be forwarded with facility to any part of the United States, and insurance to any place can be effected at a moderate premium.

I have now on my order-books the names of two thousand one hundred physicians, in various parts of the United States, and I have a right thus publicly to say, that from nearly every one I have received expressions of satisfaction with the articles which I have furnished them. The recommendations which they have, in many instances, given of me to their friends, have induced on my part increased efforts to serve and please them, and to merit the confidence thus reposed in me. For these signal services, I now tender them my grateful acknowledgments.

GEO. W. CARPENTER.

June 10, 1833.

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Physicians who wish to be supplied with this publication, will please forward their address, *post-paid*, naming the office most convenient to them, and they will receive annually a copy of it as soon as published.

Acknowledgments to Friends and Correspondents.

REMARKS.

This method has been adopted, because it is not always possible for me to write letters of acknowledgment, even, in cases where they might be reasonably expected; and still more impracticable is it for me to prepare and insert in this Journal, notices of all the books and pamphlets, which are kindly sent to me by their authors, editors or publishers.

In many cases, such notices would be appropriate, and well deserved; but it is often equally beyond my power to frame them, or even to read the works; although, judicious notices from other hands, would usually find both acceptance and insertion.

It is rarely proper to publish personal concerns, or to excuse any apparent neglect of courtesy, by pleading the unintermitting pressure of multiform duties, and the fortuitous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

This apology is drawn from me, that I may not appear inattentive to the civilities of many respected persons, both at home and abroad. It is my endeavor to reply to all letters which appear to require an answer: many other acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.

Foreign and Retrospective.

Received—From M. Alex. Brongniart:

Essai sur La Géographie Mineralogique des Environs de Paris, &c.; par G. Cuvier and Alex. Brongniart. Ed. 1811, quarto, with numerous plates. Do. 1822, much enlarged and improved.

Essai sur les Orbicules Silicieux, 1831, much enlarged.

Histoire Naturelle de l'Eau, &c. 1819.

Notice sur les Brèches osseuses et les Minerais de fer pisiforme de méme position geognostique. 1828.

Notice sur des Blocs de Roches des Terrains de Transport en Suede. 1828.

Sur le Gisement, &c. des Ophiolites, Euphotides, Jaspes, &c. dans quelques Parties des Appennins. 1821.

Macigno.

Memoire sur une nouvelle espèce de Mineral de la classe des sels, nommée Glauberite. 1808.

Notice sur la Magnesite du Bassin de Paris, &c. 1822.

De L'Arkose, Caractères Mineralogiques, et Histoire Geognostique, &c. 1826.

Sur les Caractéres Zoologiques des Formations, &c. 3 copies. 1821.

Lettre à M. G. Cuvier et Brongniart sur un terrain d' eau douce, &c. 1821.

Observations Additionelles à la Notice sur les Minerais de Fer Pisiforme, &c. 1829.

Lettre à M. Alex. Brongniart, &c. par M. Leopold de Buch.

Memoire sur Les Terrains de Sediment superieurs, calcaréo-trappéens, du Vicentin, &c. 1823.

Histoire Naturelle des Crustacés Fossiles, par M. Alex. Brongniart et A. G. Demarest; from M. Brongniart. 1822.

Sur la Classification et la distribution des Vegetaux Fossiles, par M. Adolphe Brongniart. 1822; from the author.

Observations sur les Fucoides, &c. par M. Adolphe Brongniart—1823; from the author.

Received from others.

Programme de la Séance de Inauguration des Bustes de Louis XVIII. &c. 1821.

Annales des Sciences Naturelles, Atlas. 1828.

Essai sur la temperature de l'Interieur de La Terre, par M. L. Cordier; from the author. 1828.

Rapport sur le Fossile trouvè a Long-Rocher. 1824.

Memoria sopra i Tremuoti della Sicilia in 1823, del Signor Ferrara; from the author. 1823.

Recherches sur Les Plantes connues des anciens sous le nom de Ulva par A. T. De Berneaud.

Examen Analytique de la Conference de L'Eveque de Hermopolis, dans laquelle Moïse est consideré comme Historien des temps primitifs; by Baron Ferussac.

Lettre de M. Leopold de Buch à M. Alex. De Humboldt, renfermant le Tableau Géologique du Tyrol Méridional; from the author.

De L'Art du Fontenier Sondeur et des Puits Artésiens, &c. par F. Garnier, quarto, with numerous plates; supposed to be from the author.

Philosophie Anatomique des Organes Respiratoires, &c. par M. Le Chev. Geoffroy Saint Hilaire; from the author, through M. Milbert.

Various Works on Physical Science and its applications, (in Swedish,) from Prof. Sefström, of Fahlun, Sweden.

Numerous maps of different parts of Sweden and Norway; from the same.

Disquisitionum Mineralogico-Analyticarum, Particula III. & VI. Upsal, Sweden.

Description of Geological Specimens, from the Coast of Australasia, by Dr. Fitton. 1826; from the author.

Memoir on the Geology of Central France, and on the Volcanic Region of Auvergne, Velay and Viverais; quarto, with a splendid Atlas—1827, by Mr. Poulett Scrope; from the author.

Die Physiognomie des Pflanzenreiches in Brasilien, by Dr. C. F. P. Von Martin; Munich, Bavaria; from the author.

Lyconophora—Novum Plantarum Genus; by and from the same.

Notice of the Plesiosaurus and Ichthyosaurus, by Professor Conybeare; from the author.

Notice of the Megalosaurus or great Lizard of Stonesfield, near Oxford, by Prof. Buckland, 1824; from the author.

Dr. Buckland's Reliquiæ Diluvianæ—1822; 2 copies, one for the Am. Geol. Soc. from the author.

Notice of the Fossil Elk of Ireland; the same.

Vindiciæ Geologicæ, 2 copies; the same.

On the South-Western Coal District of England, with numerous plates, by Rev. W. Buckland and Rev. W. D. Conybeare; from the authors—1824.

Geological Account of Animal and Vegetable Remains, collected by I. Crawfurd, Esq. in Ava; by Prof. Buckland, with very fine models, in plaster, of the teeth and jaws of several species of Oriental Mastodon; from Dr. Buckland.

R. I. Murchison, Esq. on the Brora Coal Field, with plates; from the author, through Mr. Featherstonhaugh.

Notes on the Geography and Geology of Lake Huron, by Dr. I. I. Bigsby—1824.

On the Magnesian Limestone, and the new Red Sandstone in the middle and north of England; by Rev. Prof. A. Sedgwick—1826 and 1828; from the author.

Dr. Fitton's Directions for collecting Geological Specimens.

His Address at the Anniversary of the Geol. Soc. Feb. 1829; from the author.

Art d'Attelier les Animaux selon leur force, par A. Teyssèdre; 1826.

Eloge Historique de André Thonin, par M. A. T. De Berneaud.

Foreign.

Prof. Berzelius's System of Chemistry, Vols. VI. and VII., from the author; the five first volumes having been already acknowledged.

Transactions of the Literary and Historical Society of Quebec, Vol. II. and Parts 1 and 2 of Vol. III., for April and July; from the Society.

Transactions of the Royal Society of Edinburgh, Vol. XI. Part 2 and Vol. XII. Part 1, quarto; from the Society.

Mr. Murchison's Memoir on a Fossil Fox found at Æningen near Constance, with an account of the geological deposit; the anatomical description by Mr. Mantell—presented by the latter.

Dr. Fitton's Geological Sketch of the vicinity of Hastings, England, from Gideon Mantell, Esq.

The Geology of the South East of England, by Gideon Mantell, F. R. S. &c. From the author.

Fossils of the South Downs, or Illustrations of the Geology of Sussex, by Gideon Mantell, F. R. S.; quarto, with numerous plates by Mrs. Mantell: 1822.

Illustrations of the Geology of Sussex, England, with figures and descriptions of Tilgate Forest, by Gideon Mantell, F. R. S.; 1827. Both these from the author.

M. Alex. Brongniart's Mémoire sur les Terrains de Sediment Supérieurs Calcaréo-Trappéens du Vicentin; from G. Mantell, Esq.

Experimental Researches in Electricity, third series, by Prof. Faraday of the Royal Institution, London; from the author, 1833.

A Scientific Catalogue of the Organic Remains of Sussex, England, by Gideon Mantell, Esq.; from the author, 1829.

Revista Bimestre Cubana, Julio de 1833.

Domestic.

Say's American Entomology, with numerous colored plates and a glossary, from Horace Binney, Esq.

Transactions of the Philosophical Society of Philadelphia, for 1831 and 1832; from the Society.

Observations on Fevers, by Dr. Elijah Griffiths; 1828.

On the use of cupping glasses for poisoned wounds; 1828.

A new Theory of Terrestrial Magnetism, by Samuel L. Metcalf. New York; from the author; 1833.

A Narrative of the Embarrassments and Decline of Hamilton College, by Henry Davis, D. D., President. From the author.

A new method for the Instruction of the Blind; also a new method of Cryptography, &c.; by Wm. Thompson, Esq. From J. P. Ayres, Nashville, Tenn.

Baccalaureate Address of the Rev. President at the Commencement of Nashville University, Oct. 3, 1833.

Prof. Follen's Funeral Oration at the burial of Dr. Spurzheim, Nov. 1832; from the author.

Annual Report of the Prison Discipline Society, 1830.

Do. 1832.

American Almanac, 1833; from Jos. E. Worcester.

Seventeenth Annual Report of the American Education Society.

Catalogue General de la Libraire, &c. Française, Anglais, &c. &c. de Charles de Behr; 1833. New York.

Address before the Annual Meeting of the American Temperance Society in New York, May 7, 1833, by Gerrit Smith.

Waldie's Select Circulating Library, Vol. I, No. 14; Philadelphia, 1833.

Seventeenth Report of the American Asylum at Hartford, May, 1833.

Dr. Joslin's Discourse before the Φ Β Κ, Schenectady, 1833; from the author.

American Quarterly Temperance Magazine, Albany; No. 2; May, 1833.

Familiar Lessons in Mineralogy and Geology, by Jane Kilby Welsh; Boston, 1833. From the author.

Farmer's Register, Vol. I; Richmond, Va. 1833.

Address on the use and application of knowledge, delivered at Manchester, R. I., by John Gurney; from Prof. Griscom.

The sin of slavery and its remedy, by Prof. Wright of the Western Reserve College: from the author.

Four Sermons preached in the Chapel of the Western Reserve College, by Beriah Green; from the author.

The Military and Naval Magazine, Vol. II, No. 1; Washington, 1833.

The Knickerbocker or New York Monthly Magazine, Nos. 1, 2, and 3; Timothy Flint, Editor.

Oration on the 4th of July, by Thomas S. Grimké; with the Farewell Address of Col. Drayton. From the author.

The sequel in the next No.

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The price of this Journal, on account of a limited patronage, and *the expense of numerous plates*, is, necessarily, more than that of the quarterly Literary Reviews. At five dollars, it would not pay for the *materiel* and the mechanical labor.

TO CORRESPONDENTS.

The titles of pieces and persons, must be fully given, or the Editor will not be responsible for mistakes or omissions.

It must be specified to the Editor, when payment is desired for communications, or they will be considered as gratuitous. In the latter case, extra copies of their pieces, will, if desired, be furnished *gratis* to contributors.

Communications have been received on the Mineralogy of Jefferson and St. Laurence Counties, N. Y.—On the Prairies of Alabama—On American Gypsies—On New Galvanometers—On the New Researches of Wöhler and Leibig, respecting Benzoic Acid—On the Phosphorescence of the Sea—On the Green Lizard, &c.—On Galvanic Excitement of an executed man, and most of these papers, or notices of them, will appear.