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This book contains the first four issues of the Journal, each with its own Table of Contents:

In issue No. 2, the incorrect numbering of Articles in the text has been left unchanged. The Table of Contents for this issue is correct. This error is noted in an Addendum, Footnote [16], by the publisher.

Obvious typographical errors and punctuation errors have been corrected after careful comparison with other occurrences within the text and consultation of external sources.

More detail can be found at the end of the book.

THE

AMERICAN

JOURNAL OF SCIENCE,

MORE ESPECIALLY OF

MINERALOGY, GEOLOGY,

AND THE

OTHER BRANCHES OF NATURAL HISTORY;

INCLUDING ALSO

AGRICULTURE

AND THE

ORNAMENTAL AS WELL AS USEFUL

ARTS.

CONDUCTED BY

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Professor of Chemistry, Mineralogy, &c. in Yale College; Author of Travels in England, Scotland, and Holland, &c.; and Member of various Literary and Scientific Societies.

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ADVERTISEMENT.

In the following plan of this Work, we trust it will be understood, that we do not pledge ourselves that all the subjects mentioned shall be touched upon *in every Number*. This is plainly impossible, unless every article should be very short and imperfect. All that the Public are entitled to expect is, that in the progress of the Journal, the various subjects mentioned may occupy such an extent as our communications and resources shall permit.

We have been honoured by such a list of names of gentlemen who are willing to be considered as contributors to this Journal, that the publication of it would afford us no [iv] ordinary gratification, did we not feel that it is more decorous to allow their names to appear with their communications, without laying them under a previous pledge to the Public.

PLAN OF THE WORK. [v]

This Journal is intended to embrace the circle of THE PHYSICAL SCIENCES, with their application to THE ARTS, and to every useful purpose.

It is designed as a deposit for *original American communications*; it will contain also occasional selections from Foreign Journals, and notices of the progress of Science in other countries. Within its plan are embraced

NATURAL HISTORY, in its three great departments of MINERALOGY, BOTANY, and ZOOLOGY.

CHEMISTRY and NATURAL PHILOSOPHY, and their various branches: and MATHEMATICS, pure and mixed.

It will be a leading object to illustrate AMERICAN NATURAL HISTORY, and especially our MINERALOGY and GEOLOGY.

The APPLICATIONS of these sciences are obviously as numerous as *physical arts*, and *physical wants*; for no one of these arts or wants can be named which is not connected with them.

While SCIENCE will be cherished *for its own sake*, and with a due respect for its own *inherent* dignity; it will also be employed as the *hand-maid to the Arts*. Its numerous applications to AGRICULTURE, the earliest and most important of them: to MANUFACTURES, both mechanical and chemical; and, to DOMESTIC ECONOMY, will be carefully sought out, [vi] and faithfully made.

It is within the design of this Journal to receive communications likewise on MUSIC, SCULPTURE, ENGRAVING, PAINTING, and generally on the fine and liberal, as well as useful arts;

On Military and Civil Engineering, and the art of Navigation;

Notices, Reviews, and Analyses of new scientific works; accounts of Inventions, and Specifications of Patents;

Biographical and Obituary Notices of scientific men; essays on COMPARATIVE ANATOMY and PHYSIOLOGY, and generally on such other branches of medicine as depend on scientific principles;

Meteorological Registers, and Reports of Agricultural Experiments: and interesting Miscellaneous Articles, not perhaps exactly included under either of the above heads.

Communications are respectfully solicited from men of science, and *from men versed in the practical arts*.

Learned Societies are invited to make this Journal, occasionally, the vehicle of their communications to the Public.

The Editor will not hold himself responsible for the sentiments and opinions advanced by his correspondents: he will consider it as an allowed liberty to make slight *verbal alterations*, where errors may be presumed to have arisen from inadvertency.

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THE

AMERICAN

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INTRODUCTORY REMARKS.

The age in which we live is not less distinguished by a vigorous and successful cultivation of physical science, than by its numerous and important applications to the practical arts, and to the common purposes of life.

In every enlightened country, men illustrious for talent, worth, and knowledge, are ardently engaged in enlarging the boundaries of natural science; and the history of their labours and discoveries is communicated to the world chiefly through the medium of Scientific Journals. The utility of such Journals has thus become generally evident; they are the heralds of science; they proclaim its toils and its achievements; they demonstrate its intimate connexion as well with the comfort, as with the intellectual and moral improvement of our species; and they often procure for it enviable honours and substantial rewards.

In England the interests of science have been, for a series of years, greatly promoted by the excellent Journals of Tilloch and Nicholson; and for the loss of the latter, the scientific world has been fully compensated by Dr. Thomson's Annals of Philosophy, and by the Journal of Science and the Arts, both published in London. [2]

In France, the Annales de Chimie et de Physique, the Journal des Mines, the Journal de Physique, &c. have long enjoyed a high and deserved reputation. Indeed, there are few countries in Europe which do not produce some similar publication; not to mention the transactions of learned societies and numerous medical Journals.

From these sources *our* country reaps, and will long continue to reap, an abundant harvest of information: and if the light of science, as well as of day, springs from the east, we will welcome the rays of both; nor should national pride induce us to reject so rich an offering.

But can we do nothing in return? In a general diffusion of useful information through the various classes of society, in activity of intellect, and fertility of resource and invention, characterizing a highly intelligent population, we have no reason to shrink from a comparison with any country. But the devoted cultivators of *science*, in the United States, are comparatively few; they are, however, rapidly increasing in number. Among them are persons distinguished for their capacity and attainments, and notwithstanding the local feelings nourished by our state sovereignties, and the rival claims of several of our larger cities, there is evidently a predisposition towards a concentration of effort, from which we may hope for the happiest results, with regard to the advancement of both the science and the reputation of our country.

Is it not, therefore, desirable to furnish some rallying point, some object sufficiently interesting to be compassed by common efforts, and thus to become the basis of an enduring, common interest? To produce these efforts, and to excite this interest, nothing, perhaps, bids fairer than a Scientific Journal. Hitherto nearly all our exertions, of this kind, have been made by medical gentlemen, and directed primarily to medical objects. We are neither ignorant nor forgetful of the merits of our various Medical Journals, nor of the zeal with which, as far as consistent with their main object, they have fostered the physical sciences. We are aware, also, that Journals have [3] been established, *professedly* deriving their materials principally from foreign sources; that our various literary Magazines and Reviews have given, and continue to give, some notices of physical and mathematical subjects, and that some of them seem even partial to these branches of knowledge: that various limited efforts have been made, and are still making, to publish occasional or periodical papers, devoted to mathematical or physical subjects, and that even our newspapers sometimes contain scientific intelligence. We are aware, also, that some of our academies and societies of natural history, either in Journals of their own, or through the medium of existing magazines, communicate to the public the efforts of their members in various branches of natural science.

But all these facts go only to prove the strong tendency which exists in this country towards the cultivation of physical science, and the inadequacy of the existing means for its effectual promulgation.

Although our limits do not permit us, however much inclined, to be more particular in commemorating the labours and in honouring the performances (often marked by much ability) of our predecessors and cotemporaries, there is one effort which we are not willing to pass by without a more particular notice; and we are persuaded that no apology is necessary for naming the Journal of the late Dr. Bruce, of New-York, devoted principally to mineralogy and geology.

No future historian of American science will fail to commemorate this work as our earliest *purely scientific* Journal, supported by *original American communications*.

Both in this country and in Europe, it was received in a very flattering manner; it excited, *at home*, great zeal and effort in support of the sciences which it fostered, and, *abroad*, it was hailed as the harbinger of our future exertions. The editor was honoured with letters on the subject of his Journal, and with applications for it from most of the countries in Europe; but its friends had to regret that, although conducted in a manner perfectly to their satisfaction, it appeared only at distant intervals, and, after the lapse of several years, never proceeded beyond the fourth number.

The hopes of its revival have now, unhappily, become completely extinct, by the lamented death [4]
of Dr. Bruce.[1]

This gentleman, with an accomplished education, with extensive acquirements in science, and great zeal for promoting it in his own country; advantageously and extensively known in Europe, and furnished with a correct and discriminating mind, and a chaste, scientific taste, was so well qualified for the task which he had undertaken, that no one can attempt to resume those scientific labours which he has now *for ever* relinquished, without realizing that he undertakes an arduous enterprise, and lays himself under a heavy responsibility. American science has much to lament in the death of Dr. Bruce.

No one, it is presumed, will doubt that a Journal devoted to science, and embracing a sphere sufficiently extensive to allure to its support the principal scientific men of our country, is greatly needed; if cordially supported, it will be successful, and if successful, it will be a great public benefit.

Even a failure, in so good a cause, (unless it should arise from incapacity or unfaithfulness,) cannot be regarded as dishonourable. It may prove only that the attempt was *premature*, and that our country is not yet ripe for such an undertaking; for *without the efficient support of talent, knowledge*, and *money, it cannot long proceed*. No editor can hope to carry forward such a work without the active aid of scientific and practical men; but, at the same time, the public
have a right to expect that he will not be sparing of his own labour, and that his work shall be [5]
generally marked by the impress of his own hand. To this extent the editor cheerfully acknowledges his obligations to the public; and it will be his endeavour faithfully to redeem his pledge.

Most of the periodical works of our country have been short-lived. *This*, also, *may* perish in its infancy; and if any degree of confidence is cherished, that it will attain a maturer age, it is derived from the obvious and intrinsic importance of the undertaking; from its being built upon permanent and momentous national interests; from the evidence of a decided approbation of the design, on the part of men of the first eminence, obtained in the progress of an extensive correspondence; from assurances of support, in the way of contributions, from men of ability in many parts of the union; and from the existence of *such a crisis* in the affairs of this country and of the world, as appears peculiarly auspicious to the success of every wise and good undertaking.

As regards the subjects of this work, it is in our power to do much in the department of the natural history of this country. Our Zoology has been more fully investigated than our mineralogy and botany; but neither department is in danger of being exhausted. The interesting travels of Lewis and Clark have recently brought to our knowledge several plants and animals before unknown. Foreign naturalists frequently explore our territory; and, for the most part, convey to Europe the fruits of their researches, while but a small part of our own productions is examined and described by Americans: certainly, this is little to our credit, and still less to our advantage. Honourable exceptions to the truth of this remark are furnished by the exertions of some gentlemen in our principal cities, and in various other parts of the Union.[2]

Our botany, it is true, has been extensively and successfully investigated; but this field is still
rich, and rewards every new research with some interesting discovery. Our mineralogy, however, [6]
is a treasure but just opened. That both science and art may expect much advantage from this source, is sufficiently evinced by the success which has crowned the active efforts of a few ardent cultivators of this science: several new species of minerals have been added to it in this country; great numbers of American localities discovered, and interesting additions made to our materials, for the useful and ornamental arts. The science of mineralogy is now illustrated by courses of lectures, and by several good cabinets in the different states. Among the cabinets, the splendid collection of Colonel Gibbs, now in Yale College, (a munificent DEPOSIT for the benefit of his country,) *stands pre-eminent*: it would be considered as a very noble cabinet in any part of Europe: and its introduction into the United States, and its *gratuitous* dedication to the promotion of science, are equally advantageous to the community, and honourable to its patriotic and enlightened proprietor. Mineralogy is most intimately connected with our arts, and especially with our agriculture.

Such are the disguises worn by many most useful mineral substances, that an unskilful observer is liable to pass a thing by, as worthless, which, if better informed, he would seize with avidity; and, still more frequently, a worthless substance, clothed perhaps in a brilliant and attractive exterior, excites hopes altogether delusive, and induces expense, without a possibility of remuneration. A diffusion of correct knowledge on this subject is the only adequate remedy for either evil.

Our geology, also, presents a most interesting field of inquiry. A grand outline has recently been drawn by Mr. Maclure, with a masterly hand, and with a vast extent of personal observation and labour: but to fill up the detail, both observation and labour still more extensive are demanded; nor can the object be effected, till more good geologists are formed, and distributed over our extensive territory.

To account for the formation and changes of our globe, by excursions of the imagination, often splendid and imposing, but usually visionary, and almost always baseless, was, till within half a
century, the business of geological speculations; but this research has now assumed a more sober [7]

character; the science of geology has been reared upon numerous and accurate observations of *facts*; and standing thus upon the basis of induction, it is entitled to a rank among those sciences which Lord Bacon's Philosophy has contributed to create. Geological researches are now prosecuted, by actually exploring the structure and arrangement of districts, countries, and continents. The obliquity of the strata of most rocks, causing their edges to project in many places above the surface; their exposure in other instances, on the sides or tops of hills and mountains; or, in consequence of the intersection of their strata, by roads, canals, and river-courses, or by the wearing of the ocean; or their direct perforation, by the shafts of mines; all these causes, and others, afford extensive means of reading the interior structure of the globe.

The outlines of American geology appear to be particularly grand, simple, and instructive; and a knowledge of the important facts, and general principles of this science, is of vast practical use, as regards the interests of agriculture, and the research for useful minerals. Geological and mineralogical descriptions, and maps of particular states and districts, are very much needed in the United States; and to excite a spirit to furnish them will form one leading object of this journal.

The science of natural philosophy, with its powerful auxiliary, mathematics, and the science of chemistry, the twin sister of natural philosophy, are of incalculable importance to this country. A volume would not suffice to trace their applications, and to enumerate the instances of their utility.

As one which may be allowed to stand, *instar omnium*, we may mention the steam engine; that legitimate child of physical and chemical science—at once more powerful than the united force of the strongest and largest animals, and more manageable than the smallest and gentlest; raising from the bowels of the earth the massy treasures of its mines, drawing up rivers from their channels, and pouring them, in streams of life, into the bosom of cities; and, above all, propelling against the currents, the winds, and the waves of the ocean, those stupendous vessels, which combine speed with certainty, and establish upon the bosom of the deep the luxuries and [8]
accommodations of the land.

The successful execution of this magnificent design was first witnessed upon the waters of the Hudson, but is now imitated in almost every civilized country; and it remains to be seen whether they will emulate us by transporting, by the same means, and against the same obstacles, the most formidable trains of artillery.

The mechanical inventions of this country are numerous; many of them are ingenious, and some are highly important. In no way can a knowledge of them be so readily and extensively diffused as in a scientific journal. To this object, therefore, a part of our labours (should there be a call for it,) will be devoted, and every necessary aid will be given by plates and descriptions.

Science and art mutually assist each other; the arts furnish facts and materials to science, and science illuminates the path of the arts.

The science of mathematics, both pure and mixed, can never cease to be interesting and important to man, as long as the relations of quantity shall exist, as long as ships shall traverse the ocean, as long as man shall measure the surface or heights of the earth on which he lives, or calculate the distances and examine the relations of the planets and stars; and as long as the *iron reign of war* shall demand the discharge of projectiles, or the construction of complicated defences.

In a word, the whole circle of physical science is directly applicable to human wants, and constantly holds out a light to the practical arts; it thus polishes and benefits society, and every where demonstrates both supreme intelligence, and harmony and beneficence of design in THE CREATOR.

ART. I. *Essay on Musical Temperament.*[3] [9]

By Professor FISHER, of Yale College.

It is well known to those who have attended to the subject of musical ratios, that a fixed scale of eight degrees to the octave, which shall render all its concords perfect, is impossible. It has been demonstrated by Dr. Smith, from an investigation of all the positions which the major, the minor, and the half-tone can assume, that the most perfect scales possible, of which there are two equally so, differing only in the position of the major and the minor tone above the key note, must have one Vth and one 3d too flat, and consequently the supplementary 4th and VIth too sharp, by a comma. In vocal music, and in that of perfect instruments, this defect in the scale is not perceived, because a small change may be made in the key, whenever the occurrence of either of those naturally imperfect intervals renders such a change necessary to perfect harmony. But in instruments with fixed scales, such as the guitar, the piano-forte, and the organ, if we begin with tuning as many concords as possible perfect, the resulting chords above-mentioned will be necessarily false in an offensive degree. Hence it is an important problem in practical harmonics, to distribute these imperfections in the scale among the different chords, in such a manner as to occasion the least possible injury to harmony.

But this is not the only nor the principal difficulty which the tuner of imperfect instruments has to encounter. In order that these instruments may form a proper accompaniment for the voice, and be used in conjunction with perfect instruments, it is necessary that music should be capable of being executed on them, in all the different keys in common use; and especially that they should be capable of those occasional modulations which often occur in the course of the same piece. Now only five additional sounds to the octave are usually inserted for this purpose, between those of the natural scale, which, of course, furnish it with only three sharps and two flats. Hence, when a greater number of flats or sharps is introduced, the music can be executed [10] only by striking, in the former case, the sharp of the note next below; and, in the latter, the flat of the note next above. But as the diatonic semitone is more than half the major, and much more than half the minor tone, if the additional sounds in the common artificial scale be made perfect for one of the above employments, they must be extremely harsh for the other. Hence arises the necessity of adjusting the position of these five inserted sounds so that they may make tolerable harmony, whichever way employed. A change in these will require corresponding changes in the position of the several degrees of the natural scale; so that it is highly probable that the best scheme of temperament will leave no concord, either of the natural or artificial scale, absolutely perfect.

In adjusting the imperfections of the scale, the three following considerations have been usually taken into view.

I. One object to be aimed at is, to make the sum of the temperaments of all the concords the least possible. Since experience teaches us that the harshness of a given concord increases with its temperament, it is obvious that of two systems which agree in other respects, the best is that in which the sum of the temperaments is least.

II. When other things are equal, the best adjustment of the imperfections of the scale is that which diminishes the harmoniousness of all the different concords proportionally. The succession of a worse to a better harmony, is justly regarded by several of the best writers on this subject, as one of the principal causes of offence to the ear, in instruments imperfectly tuned.

III. When different chords of the same kind are of unequally frequent occurrence, there is an advantage, *cæteris paribus*, in giving the greatest temperament to that which occurs most seldom. This important consideration has indeed been neglected by Dr. Smith, in the systems which he recommends, both for his changeable and the common fixed scale; as it is, also, by the numerous advocates of the system of equal semitones. But many authors on temperament, and most instrument-makers, pay a vague regard to it. Their aim has been, although in a loose and [11] conjectural manner, to make the prominent chords of the simplest keys the nearest to perfection, whilst a greater temperament is thrown upon those which occur only in the more complex keys. Thus Dr. Young, in the Philos. Trans. for 1800, recommends a scheme which increases the temperament of the IIIds, on the key note of the successive keys, as we modulate by fifths from C, nearly in arithmetical progression. Earl Stanhope assigns as a reason for the small temperament which is given to several of the IIIds in his system, that they are on the tonic of the simpler keys. The irregularities in Mr. Hawkes's scheme may be traced to the same cause. And, with the instrument-makers, it is a favourite maxim to lay the wolf, as they term it, where it will be most seldom heard.

But if the above consideration deserves any weight at all, it deserves to be accurately investigated. Not only ought the relative frequency of different chords to be ascertained with the greatest accuracy, of which the nature of the subject is susceptible, but the degree of weight which this consideration ought to have, when compared with the two others above-mentioned, should be determined: for it is plain that neither of them ought to be ever left out of view.

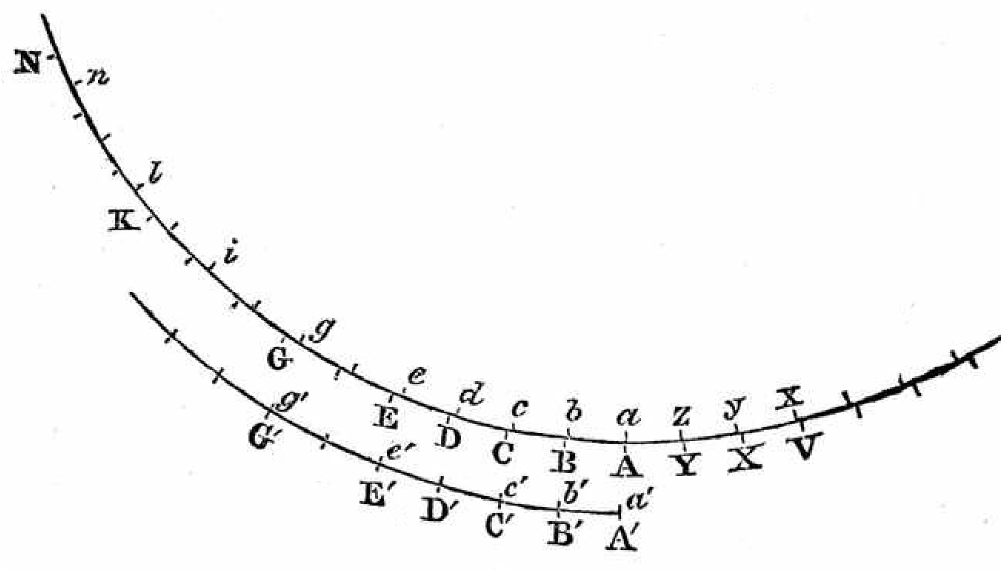
Accordingly, the principal design of the following propositions will be to investigate the actual frequency of occurrence of different chords in practice; and from this and the two other above-mentioned considerations united, to deduce the best system of temperament for a scale, containing any given number of sounds to the octave, and particularly for the common Douzeave, or scale of twelve degrees.

Proposition I.

All consonances may be regarded, without any sensible error in practice, as equally harmonious in their kinds, when equally tempered; and when unequally tempered, within certain limits, as having their harmoniousness diminished in the direct ratio of their temperaments.

As different consonances, when perfect, are not pleasing to the ear in an equal degree, some approaching nearer to the nature of discords than others, so a set of tempered consonances, [12] *cæteris paribus*, will be best constituted when their harmoniousness is diminished *proportionally*. Suppose, for example, that the agreeable effects of the Vth, IIId, and 3d, when perfect, are as any unequal numbers, a, b, and c; the best arrangement of a tempered scale, other things being equal, would be, not that in which the agreeable effect of the Vth was reduced to an absolute level with that of the IIId, or 3d, but when they were so tempered that their agreeable effects on the ear might be expressed by $\frac{m}{n} a$, $\frac{m}{n} b$, $\frac{m}{n} c$.

That different consonances, in this sense, are equally harmonious in their kinds, when equally tempered, or, at least, sufficiently so for every practical purpose, may be illustrated in the following manner:



Let the lines AB, *ab*, represent the times of vibration of two tempered unisons. Whatever be the ratio of AB to *ab*, whether rational or irrational, it is obvious that the successive vibrations will alternately recede from and approach each other, till they very nearly coincide; and, that during one of these periods, the longer vibration, AB, has gained *one* of the shorter. Let the points, A, B, &c. represent the middle of the successive times of vibration of the lower; and *a*, *b*, &c. those of [13] the higher of the tempered unisons. Let the arc AGN..VA be a part of a circle, representing one period of their pulses, and let the points A, *a*, be the middle points of the times of those vibrations which approach the nearest to a coincidence. It is obvious that the dislocations *b*B, *c*C, &c. of the successive pulses, increase in a ratio which is very nearly that of their distances from A, or *a*. Now if the pulses exactly coincided, the unisons would be perfect; and the same would be equally true, if the pulses of the one bisected, or divided in any other constant ratio, those of the other; as clearly appears from observation. It is, therefore, not the absolute magnitude, as asserted by Dr. Smith, but the *variableness* of the successive dislocations, B*b*, C*c*, &c. which renders the imperfect unisons discordant; and the magnitude of the successive increments of these dislocations is the measure of the degree of discordance heard in the unisons.

If now the time of vibration in each is doubled, AC, *ac*, &c. will represent the times of vibration of imperfect unisons an octave below, and the successive dislocations will be C*c*, E*e*, &c. only half as frequent as before. But the unisons AE, *ae*, will be equally harmonious with AB, *ab*; because, although the successive dislocations are less frequent than before, yet the coincidences C′*c′*, E′*e′* of the corresponding perfect unisons are less frequent in the same ratio.

Suppose, in the second place, that the time of vibration is doubled, in only one of the unisons, *ab*; and that the times become AB and *ac*, or those of imperfect octaves. These will also be equally harmonious in their kind with the unisons AB, *ab*. For, although the dislocations C*c*, E*e*, &c. are but half as numerous as before, the coincidences of the corresponding perfect octaves will be but half as numerous. The dislocations which remain are the same as those of the imperfect unisons; and if some of the dislocations are struck out, and the increments of successive ones thus increased, no greater change is made in the nature of the imperfect than of the perfect consonance.

If, thirdly, we omit two-thirds of the pulses of the lower unison, retaining the octave *ac* of the [14] last case, we shall have AD, *ac*, the times of vibration of imperfect Vths, to which, and to all other concords, the same reasoning may be applied as above. It may be briefly exhibited thus; since the intermission of the coincidences C′*c′*, E′*e′* of the perfect unisons, an octave below A′B′, does not render the Vth A′D′G′ *a′c′e′g′* less perfect than the unison A′*c′ a′c′*, each being perfect in its kind; so neither does the intermission of the corresponding dislocations C*c*, E*e*, of the tempered unisons, in the imperfect Vth, ADG, *aceg*, render it less harmonious in its kind than the tempered unison AB, *ab*, from which it is derived in exactly the same manner that the perfect Vth is derived from the perfect unison.

The consonances thus derived, as has been shown by Dr. Smith, will have the same periods, and consequently the same beats, with the imperfect unisons. It is obvious, likewise, that they will all be equally tempered. Let *m* AB, and *n ab*, be a general expression for the times of vibration of any such consonance. The tempering ratio of an imperfect consonance is always found by dividing the ratio of the vibrations of the imperfect by that of the corresponding perfect consonance. But $\frac{m\,\mathrm{AB}}{n\,ab} \div \frac{m}{n} = \frac{\mathrm{AB}}{ab}$; which is evidently the tempering ratio of the imperfect unisons.

Hence, so far as any reasoning, founded on the abstract nature of coexisting pulses can be relied on, (for, in a case of this kind, rigid demonstration can scarcely be expected,) we are led to conclude that the harmoniousness of different consonances is proportionally diminished when they are equally tempered.

The remaining part of the proposition, viz. that consonances differently tempered have their harmoniousness diminished, or their harshness increased, in the direct ratio of their temperaments, will be evident, when we consider that the temperament of any consonance is the sole cause of its harshness, and that the effect ought to be proportioned to its adequate cause. [15] We may add, that the rapidity of the beats, in a given consonance, increases very nearly in the ratio of the temperament; and universal experience shows, that increasing the rapidity of the beats of the same consonance, increases its harshness. This is on the supposition that the consonance is not varied so much as to interfere with any other whose ratio is equally simple.

Cor. We may hence infer, that in every system of temperament which preserves the octaves perfect, each consonance is equally harmonious, in its kind, with its complement to the octave, and its compounds with octaves. For the tempering ratio of the complement of any concord to the octave, is the same with that of the concord itself, differing only in its sign, which does not sensibly affect the harmony or the rate of beating; while the tempering ratio of the compounds with octaves is not only the same, but with the same sign.

Scholium 1.

There is no point in harmonics, concerning which theorists have been more divided in opinion than in regard to the true measure of equal harmony, in consonances of different kinds. Euler maintains, that the more simple a consonance is, the less temperament it will bear; and this seems to have ever been the general opinion of practical musicians.[4] Dr. Smith, on the contrary, asserts, and has attempted to demonstrate, that the simpler will bear a much greater temperament than the more complex consonances. The foregoing proposition has, at least, the merit of taking the middle ground between these discordant opinions. If admitted, it will greatly simplify the whole subject, and will reduce the labour of rendering all the concords in three octaves as equally harmonious as possible, which occupies so large a portion of Dr. Smith's volume, to a single short proposition. Dr. Smith's measure of equal harmony, viz. equal numbers of short cycles in the intervals between the successive beats, seems designed, not to render the different consonances proportionally harmonious, but to reduce the simpler to an absolute level, [16] in point of agreeableness, with the more complex; which, as has been shown, is not the object to be aimed at in adjusting their comparative temperaments. But, in truth, his measure is far more favourable to the complex consonances than equal harmony, even in this sense, would require; and, in a great number of instances, leads to the grossest absurdities. Two consonances, according to him, are equally harmonious, when their temperaments are inversely as the products of the least numbers expressing their perfect ratio. If so, the VIII + 3d, whose ratio is $^5/_{12}$, when tempered $^1/_{20}$ of a comma, and the unison, whose ratio is $^1/_1$, when tempered 3 commas, are equally harmonious. But all who have the least experience in tempered consonances will pronounce, at once, that the former could scarcely be distinguished by the nicest ear from the corresponding perfect concord, while the latter would be a most offensive discord. One instance more shall suffice. The temperaments to render the VIII + Vth, and the VIII + 6th equally harmonious, are laid down in his tables to be as 80 : 3. We will now suppose an instrument perfectly tuned in Dr. Smith's manner, and furnished with all the additional sounds which constitute his changeable scale. In this system, the IIIds, and consequently the VIII + 6ths, are tempered $^1/_9$ of a comma; which, so far from being offensive, will be positively agreeable to the ear. This cannot be doubted by those who admit that the VIII + 6ths in the common imperfect scales, when tempered at a medium nearly seven times as much, make tolerable harmony. Yet, according to the theory which we are opposing, the VIII + Vth will be equally harmonious when tempered nearly a minor semitone. Now let any one, even with the common instruments, whenever an VIII + Vth occurs, strike the semitone next above or below: for example, instead of playing C, *g*, let him play C, *g*♯; instead of A, *e*, let him play A, *e*♭, &c. and compare the harmony of these with that of the VIII + 6ths, if he wants any farther evidence that Dr. Smith's measure of equal harmony is without foundation.

It may be thought, that even the measure of equal harmony laid down in the proposition, is more favourable to the complex consonances than the conclusions of experience will warrant. But [17] when it is asserted by practical musicians, that the octave will bear less tempering than the Vth, the Vth less than the IIId, &c., they doubtless intend to estimate the temperament by the rate of beating, and to imply, that when different consonances to the same base are made to beat equally fast, the simpler are more offensive than the more complex consonances. This is entirely consistent with the proposition; for when equally tempered, the more complex consonances will beat more rapidly than the more simple; if on the same base, very nearly in the ratio of their major terms. (Smith's Har. Prop. XI. Cor. 4.) If, for example, an octave, a Vth, and a IIId on the same base were made to beat with a rapidity which is as the numbers 2, 3, and 5, no unprejudiced ear would probably pronounce the octave less harmonious in its kind than the IIId.

To those, on the other hand, who may incline to a measure of equal harmony between that laid down in the proposition and that of Dr. Smith, on account of the rapidity of the beats of the more complex consonances, it maybe sufficient to reply, that if the beats of a more complex consonance are more rapid than those of a simpler one, when both are equally tempered, those of the latter, cæteris paribus, are more *distinct*. It is the distinctness of the undulations, in tempered consonances, which is one of the principal causes of offence to the ear.

Scholium 2.

It will be proper to explain, in this place, the notation of musical intervals, which will be adopted in the following pages. It is well known that musical intervals are as the logarithms of their corresponding ratios. If, therefore, the octave be represented by .30103, the log. of 2, the value of the Vth will be expressed by .17509; that of the major tone by .05115; that of the comma by .00540, &c. But in order to avoid the prefixed ciphers, in calculations where so small intervals as the temperaments of different concords are concerned, we will multiply each of these values [18] by 100,000, which will give a set of integral values having the same ratio. The octave will now become 30103, the comma 540, &c.; and, in general, when temperaments are hereafter expressed by numbers, they are to be considered as so many 540ths of a comma. Had more logarithmic places been taken, the intervals would have been expressed with greater accuracy; but it was supposed that the additional accuracy would not compensate for the increased labour of computation which it would occasion. This notation has been adopted by Dr. Robinson, in the article Temperament, (Encyc. Brit. Supplement;) and for every practical purpose, is as much superior to that proposed by Mr. Farey, in parts of the Schisma, lesser fraction and minute,[5] as all decimal measures necessarily are, to those which consist of different denominations.

Proposition II.

In adjusting the imperfections of the scale, so as to render all the consonances as equally harmonious as possible, only the simple consonances, such as the Vth, IIId, and 3d, with their complements to and compounds with the octave, can be regarded.

It has been generally assigned as the reason for neglecting the consonances, usually termed discords, in ascertaining the best scheme of temperament, that they are of less frequent occurrence than the concords. This, however, if it were the only reason, would lead us, not to neglect them entirely, but merely to give them a less degree of influence than the concords, in proportion as they are less used.

A consideration which seems not to have been often noticed, renders it impossible to pay them any regard in harmonical computations. All such computations must proceed on the supposition that within the limits to which the temperaments of the different consonances extend, they become harsher as their temperaments are increased. It is evident that any consonance may be [19] tempered so much as to become better by having its temperament increased, in consequence of its approaching as near to some other perfect ratio, the terms of which are equally small; or perhaps much nearer some perfect ratio whose terms are not proportionally larger. For example, after we have sharpened the Vth more than 3 commas, it becomes more harmonious, as approaching much nearer to the perfect ratio $^5/_6$. In this, however, and the other concords, the value of the nearest perfect ratios in small numbers, varies so much from the ratios of these concords, and the consequent limits within which the last part of Prop. I. holds true, are so wide that there is no hazard in making it a basis of calculation. And if there be a few exceptions to this, in some systems, in which the temperaments of a few of the concords become so large as to approach nearer to some other perfect ratio, whose terms are nearly as small as those of the perfect concord, although they might become more harmonious, by having their temperament increased, yet their effect in *melody* would be still more impaired; so that the concords may all be considered as subjected to the same rule of calculation.

But the limits within which the second part of Prop. I. holds true, with regard to the more complex consonances, are much more limited. We cannot, for instance, sharpen the 7th, whose ratio is 9 : 16 more than ½ a comma, without rendering it more harmonious, as approaching nearer another perfect ratio which is simpler; that of 5 : 9. Yet the difference between these two 7ths is so trifling that they have never received distinct names; and, indeed, their effect on the ear in melody would not be sensibly different.

Again, the 5th, whose perfect ratio has been generally laid down as 45 : 64, but which is in reality 25 : 36,[6] cannot be sharpened more than ⅓ of a comma, before it becomes more [20] harmonious by having its temperament increased, as approaching nearer the simpler ratio 7 : 10. At the same time, the effect of this interval in melody would not be sensibly varied. The limits, within which the harmoniousness of the IVth is inversely as its temperament, are still narrower.

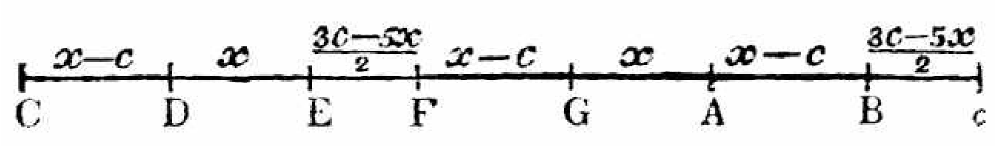
Hence it appears that no inference can be drawn from the temperaments of such consonances as the 7th, 5th, IVth, &c. respecting their real harmoniousness. The other perfect ratios which have nearly the same value with those of these chords, and which are in equally simple terms, are so numerous that by increasing their temperament they alternately become more and less harmonious; and in a manner so irregular, that to attempt to subject them to calculation, with the concords, would be in vain. Even when unaltered, they may be considered either as greater temperaments of more simple, or less temperaments of more complex ratios. Suppose the 5th, for example, to be flattened ⅕ of a comma: shall it be considered as deriving its character from the perfect ratio 25 : 36, and be regarded as flattened 108; or shall it be referred to the perfect ratio 7 : 10, and considered as sharpened 239? No one can tell.—On the whole, it is manifest that no consonances more complex than those included in the proposition, can be regarded in adjusting the temperaments of the scale.

Proposition III.

The best scale of sounds, which renders the harmony of all the concords as nearly equal as possible, is that in which the Vths are flattened $^2/_7$, and the IIIds and 3ds, each $^1/_7$ of a comma.

The octave must be kept perfect, for reasons which have satisfied all theoretical and practical harmonists, how widely soever their opinions have differed in other respects. Admitting equal temperament to be the measure of equal harmony, the complements of the Vth, IIId, and 3d, to the octave, and their compounds with octaves will be equally harmonious in their kinds with [21] these concords respectively; according to the corollary of Prop I.

Hence we have only to find those temperaments of the Vths, IIIds, and 3ds, in the compass of one octave, which will render them all, as nearly as possible, equally harmonious. The temperaments of the different concords of the same name ought evidently to be rendered equal; since, otherwise, their harmony cannot be equal. This can be effected only by rendering the major and minor tones equal, and preserving the equality of the two semitones. If this is done, the temperament of all the IIIds will be equal, since they will each be the sum of two equal tones. For a similar reason the 3ds, and consequently the Vths, formed by the addition of IIIds, and 3ds, will be equally tempered.



In order to reduce the octave to five equal and variable tones, and two equal and variable semitones, we will suppose the intervals of the untempered octave to be represented by the parts CD, DE, &c. of the line C*c*. Denoting the comma by c, we will suppose the tone DE, which is naturally minor, to be increased by any variable quantity, x; then, by the foregoing observations, the other minor tone, GA, must be increased by the same quantity. As the major tones must be rendered equal to the minor, their increment will be $x - c$. As the octave is to be perfect, the variation of the two semitones must be the same with that of the five tones, with the contrary sign; and as they are to be equally varied, the decrement of each will be $\frac{5x - 3c}{2}$; or what amounts to the same thing, the increment of each will be $\frac{3c - 5x}{2}$.

The several concords of the same name in this octave are now affected with equal and variable temperaments. The common increment of the IIIds will be $2x - c$; that of the 3ds $\frac{1}{2} \cdot \overline{c - 3x}$; and consequently that of the Vths $\frac{1}{2} \cdot \overline{x - c}$.

In adjusting these variable temperaments, so as to render the harmony of the concords of [22]
different kinds, as nearly equal as possible, we immediately discover that, as the Vth is composed of the IIId and 3d, the temperaments of the three cannot all be equal. When the temperaments of the IIId and 3d have the same sign, that of the Vths must be equal to their sum; and, when they have contrary signs, to their difference. Hence the temperament of one of these three concords is necessarily equal to the sum of that of the other two. This being fixed, the temperaments, and consequently, (by Prop. I.) the discordance of the different consonances is the most equably divided possible, when the two smaller temperaments, whose sum is equal to the greater, are made equal to each other. The problem contains three cases.

1. When the temperaments of the IIId and 3d have the same sign, they ought to be equal to each other. Making $2x - c = \frac{1}{2} \cdot \overline{c - 3x}$, we obtain $x = \frac{3}{7}\,c$, which, substituted in the general expressions for the temperaments of the Vth, IIId, and 3d, makes their increments equal to $-\frac{2}{7}\,c$, $-\frac{1}{7}\,c$, $-\frac{1}{7}\,c$, respectively.

2. Let the temperaments of the IIId and 3d have contrary signs: and first, let that of the IIIds be the greater. Then the former ought to be double of the latter, in order that the temperament of the Vths and and 3ds may be equal. Hence we have $2x - c = -2 \cdot \frac{1}{2} \cdot \overline{c - 3x}$; whence x is found = 0; and by substitution as before, the required temperament of the IIId = $-c$; of the Vth $-\frac{1}{2}\,c$, and of the 3d $\frac{1}{2}\,c$.

3. Let the temperaments of the IIId and 3d have contrary signs, as before; and let that of the 3d be the greater. Making $\frac{1}{2} \cdot \overline{c - 3x} = -2 \cdot \overline{2x - c}$, we obtain $x = \frac{3}{5}\,c$; which gives, by substitution, the temperaments of the 3d, Vth, and IIId $-\frac{2}{5}\,c$, $-\frac{1}{5}\,c$, and $\frac{1}{5}\,c$, respectively.

Each of these results makes the harmony of all the consonances as nearly equal as possible; but as the sum of the temperaments in the first case is much the least, it follows that the temperaments stated in the proposition constitute the best scheme of intervals for the natural [23]
scale, in which the harmony of all the different consonances is rendered as nearly equal as possible.

Cor. 1. In the same manner it may be shown that these temperaments are the best, among those which approach as nearly as possible to equal harmony, for the *artificial* scale; provided that it is furnished with distinct sounds for all the sharps and flats in common use. By inserting a sound between F and G, making the interval F✻G equal to either of the semitones found above, the intervals, reckoned from G as a key note, will be exactly the same in respect to their temperaments, as the corresponding ones reckoned from C. The same thing holds, whatever be the number of flats and sharps. It is supposed, however, that the flat of a note is never used for the sharp of that next below, or the contrary; and hence this scheme of temperament would only be adapted to an instrument, furnished with all the degrees of the enharmonic scale; or, at least, with as many as are in common use.

Cor. 2. This scale will differ but little in practice from the one deduced, with so much labour, by Dr. Smith, from his criterion of equal harmony; which flattens the Vths $\frac{5}{18}$, the IIIds $\frac{1}{9}$, and the 3ds $\frac{1}{6}$ of a comma. The several differences are only $\frac{1}{126}$, $\frac{2}{63}$, and $\frac{1}{42}$ of a comma. Hence, as his measure of equal harmony differs so widely from that of Proposition I. we may infer that the consideration of equalizing the harmony of the concords of different names can have very little practical influence on the temperaments of the scale. Should it, therefore, be maintained that the criterion laid down in Prop. I. is not mathematically accurate; yet, as it must be allowed, in the most unfavourable view, to correspond far better with the decisions of experience than that of Doctor Smith, the chance is, that, at the lowest estimate, the temperaments deduced from it approach much more nearly to correctness. Hence it is manifest that equal temperament may be made, *without any sensible error in practice*, the criterion of equal harmony.

[24]

Scholium 3.

Although the foregoing would be the best division of the musical scale, if our sole object were to render the harmony of its concords as nearly equal as possible, yet the two other considerations, stated at the beginning of the essay, must by no means be neglected, as has been done by Dr. Smith. It seems to be universally admitted, that the sum of the temperaments may be increased to a certain extent, in order to equalize the harmony of the concords; otherwise the natural scale of major and minor tones, which makes the sum of the temperaments of the Vths, IIIds, and 3ds but 2 commas, ought to be left unaltered. Yet how far this principle ought to be carried, may be a matter of doubt. If we make the IIIds perfect, and flatten the Vths and 3ds each ¼ *c*, according to the old system of mean tones, we shall have the smallest aggregate of temperaments which admits of the different concords of the same name being rendered equally imperfect; but this amounts to 2½ commas. Thus far, however, it seems evidently proper to proceed. If we go still farther, and endeavour to equalize the harmony of the concords of *different* names, it may be questioned whether nearly as much is not lost as gained; for the aggregate temperaments are increased, in Dr. Smith's scale, to 2⅔ *c*, and in that of the above proposition to $2\,{}^{5}/_{7}$ *c*. The system of mean tones, although more unequal in its harmony when but two notes are struck at once, yet when the chords are played full, as they generally are on the organ, never offends the ear by a transition from a better to a worse harmony. For every *triad* is equally harmonious; being composed of a perfect IIId, and a Vth and 3d, tempered each ¼ *c*, or of their complements to, or compounds with octaves, which, in their kinds, are equally harmonious.

Again, if different chords, in practice, vary in the frequency of their occurrence, this will be a sufficient reason for deviating from the system of equal temperament. Suppose, for example, that a given sum of temperament is to be divided between two Vths, one of which occurs in playing ten times as often as the other: there can be no doubt that the greater part of the temperament [25]
ought to be thrown upon the latter. Hence it becomes an important problem to ascertain, with some degree of precision, the relative frequency with which different consonances occur in practice. Before proceeding to a direct investigation of this problem, it may be observed, in general, that such a difference manifestly exists. In a given key, it cannot have escaped the most superficial observer, that the most frequent combination of sounds is the common chord on the tonic; that the next after this is that on the dominant, and the third, that on the subdominant. Perhaps scarcely a piece of music can be found, in which this order of frequency does not hold true. It is equally true that some signatures occur oftener than others. That of one sharp will be found to be more used, in the major mode, than any other; and, in general, the more simple keys will be found of more frequent occurrence than those which have more flats or sharps. These differences are not the result of accident. The tonic, dominant, and subdominant, are obviously the most prominent notes in the scale, and must always be the fundamental bases of more chords than either of the others; while the greater ease of playing on the simpler keys will always be a reason with composers for setting a larger part of their music on these, than on the more difficult keys. It is observable, that the greater part of musical compositions, whether of the major or minor mode, is reducible to two kinds: that in which the base chiefly moves between the tonic and its octave, and that in which the base moves between the dominant and subdominant of the key. The former class, in the major mode, are almost universally set on the key of one sharp; the latter, generally on the natural key, or that of two sharps. In the minor mode, the former class have usually the signature of two flats, or the natural key; the latter, that of one flat. Hence the three former keys will comprise the greater part of the music in the major mode, and the three latter, of that in the minor mode, in every promiscuous collection. But if we were even to suppose each of the chords in the same key, and each of the signatures, of equally frequent occurrence, some chords would occur much oftener, as forming an essential part of the harmony of *more keys* [26]
than others. The Vth DA, for example, forms one of the essential chords of six different keys; while the Vth G※D※ forms a part only of the single key of four sharps.

Proposition IV.

To find a set of numbers, expressing the ratio of the probable number of times that each of the different consonances in the scale will occur, in any set of musical compositions.

This can be done only by investigating their actual frequency of occurrence in a collection of pieces for the instrument to be tuned, sufficiently extensive and diversified to serve as a specimen of music for the same instrument in general. This may appear, at first view, an endless task; and it would be really such, were we to take music promiscuously, and count all the consonances which the base makes with the higher parts, and the higher parts with each other. But it appears, from Prop. I. Cor. that all the positions and inversions of a chord, when the octaves are kept perfect, are equally harmonious with the chord itself. The Vth, for example, which makes one of the consonances in a common harmonic triad, is equally harmonious in its kind, with the V + VIII, which takes its place in the 3d position of this triad, and with the 4th in its second inversion. Hence, instead of counting single consonances, we have only to count chords; and this is done with the greatest ease, by means of the figures of the thorough base. The labour will be still farther abridged by reducing the derivative chords, such as the 6, the $^{6}/_{4}$, &c. to their proper roots, as they are taken down. But even after these reductions, the labour of numbering the different chords in a sufficiently extensive set of compositions, to establish, with any degree of certainty, the relative frequency of the different signatures, would be very irksome. A method, however, presents itself, which renders it sufficient to examine the chords in such a set of pieces only as will give their chance of occurrence in *two* keys—a major, and its relative minor.

It will be evident to all who are much conversant with musical compositions, that the *internal structure* of all pieces in the same mode, whatever be their signature, is much the same. There is [27]
scarcely more difference, for example, in the relative frequency of different chords in the natural key, and in that of two sharps, or two flats, than there is in different pieces on the same key. If the Vth CG on the tonic has to the Vth EB on the mediant in the natural key, any given ratio of frequency $m : n$, the relative frequency of the Vth DA on the tonic, and the Vth F✱ C✱ on the mediant in the key of two sharps, will not sensibly differ from that of $m : n$. Hence, if we examine a sufficient number of pieces to establish the relative frequency of the different consonances in one major and its relative minor key, and, by a much more extensive investigation, ascertain the relative frequency of occurrence of the different signatures, it is evident, that by multiplying this last series of numbers into the first, and adding those products which belong to chords terminated by the same letters, we shall have a series of numbers expressing the chance of occurrence in favour of each of the consonances of the scale, when *all* the keys are taken into view.

It was judged that 200 scores, taken promiscuously from all the varieties of music for the organ,[7] would afford a set of numbers expressing, with sufficient accuracy, the chance that a given consonance will occur in a single major, and its relative minor key. Accordingly 200 scores were examined, 150 in the major, and 50 in the minor mode, (as it will appear hereafter that this is nearly the ratio of their frequency) of the various species of music for the organ, comprising a proper share both of the simpler and of the more rapid and chromatic movements. As the selecting and reducing to their proper keys all the occasional modulations which occur in the same piece would render the labour of ascertaining the relative frequency of different signatures [28]
very tedious, it was thought best to consider all those modulations which are too transient to be indicated by a new signature, as belonging to the same key. This will account for the occurrence of the chords in the following table, which are affected by flats and sharps.

The minim, or the crotchet, was taken for unity, according to the rapidity of the movement. Bases of greater or less length had their proper values assigned them; although mere notes of passage, which bore no proper harmony, were generally disregarded. The scores were taken promiscuously from all the different keys; and were reduced, when taken down, to the same tonic; the propriety of which will evidently appear from the foregoing remarks. The following table contains the result of the investigation.

TABLE I.

Bases.	Common Chords.		Flat Fifths.		7ths.		9-sevenths.	
	Major mode.	Minor mode.	Major.	Minor.	Major.	Minor.	Major.	Minor.
B III	5	8	—	—	7	—	—	—
B	3	—	163	55	11	17	2	—
B♭	4	4	—	—	—	—	—	—
A VII	—	—	—	—	—	—	3	—
A III	19	8	—	—	7	2	—	—
A	166	588	2	1	26	5	2	—
G♯	—	—	3	38	—	—	—	—
G 3	18	15	—	—	—	—	—	—
G	965	93	—	—	178	15	3	—
F♯	—	—	46	4	11	2	—	—
F	352	60	—	—	11	12	7	3
E III	26	271	—	—	1	25	—	—
E	32	25	5	1	8	—	1	4
D♯ III	—	—	2	1	—	—	—	—
D♯	—	—	—	4	—	—	—	—
D III	29	4	—	—	49	7	—	—
D	120	129	—	—	55	18	6	1
C♯	—	—	2	4	1	—	—	—
C 3	2	—	—	—	—	—	—	—
C	1769	275	—	—	5	1	4	1

The following anomalous chords were found in the major mode, and are subjoined, to make the list complete: [29]

8 ♯5ths on C, and 1 on D.
5 $^5/_4$ths on D, 2 on E, and 1 on G.

The left hand column of the foregoing table contains the fundamental bases of the several chords. When any number is annexed to the letter denoting the fundamental, it denotes the quality of some other note belonging to the chord. E III, for example, denotes that the various chords on E, which stand against it, have their third sharped; G 3, that the third, which is naturally major, is to be taken minor, &c. Of the two columns in each of the four remaining pairs, the left contains the number of chords belonging to each root, of the kind specified at the top, which were found in 150 scores in the major mode; and the right, the corresponding results of the examination of 50 scores in the minor mode. The diminished triad, which is used in harmonical progression like the other triads, has its lowest note considered as its fundamental. The diminished 7th, in the few instances in which it occurred, was considered as the first inversion of the $^9/_7$th, agreeably to the French classification, and was accordingly reduced to that head.

From this table, the number of times that each consonance of two notes would actually occur, were the 200 scores played, is easily computed. We will suppose three notes, besides octaves, to be played to each chord. The octaves played it is unnecessary to take into the computation, as it would only multiply the number of consonances whose temperament is the same, in the same ratio, and would have no effect on the *ratio* of the numbers expressing the frequency of the different consonances. In the chord of the 7th, which naturally consists of four notes, we will suppose, for the sake of uniformity, that one is omitted; and as the 7th ought always to be struck, we will suppose the Vth and IIId of the base to be omitted, each half the number of times in which this chord occurs. Considered as composed of three distinct notes, neither of which is an octave of either of the others, each chord will contain three distinct consonances. The common chord on C, for example, will contain the Vth CG, the IIId CE, and the 3d EG. The $^9/_7$ on C will [30] contain the VII CB, the IX, or (which must have the same temperament) the IId CD, and the 3d BD. Reducing all these consonances to their proper places, and adding those of the same name which have the same degree for their base, we obtain the following results:

TABLE II.

Bases.	Vths, 4ths, and Octaves.		IIIds, 6ths, and Octaves.		3ds, VIths, and Octaves.	
	Major.	Minor.	Major.	Minor.	Major.	Minor.
B	8	8	10	8	1141	214
B♭	3	6	22	19	——	——
A	195	607	22	10	626	663
G♯	——	——	——	——	32	310
G	1088	116	1090	125	22	23
F♯	——	——	——	——	78	10
F	395	78	486	301	——	——
E	59	308	40	284	1828	308
E♭	——	——	2	——	——	——
D♯	——	——	——	——	7	9
D	197	156	60	7	403	213
C♯	——	——	——	——	26	12
C	1807	278	1959	870	4	1

Bases.	5ths, IVths, and Octaves.		7ths, IIds, and Octaves.		VIIths, 2ds, and Octaves.	
	Major.	Minor.	Major.	Minor.	Major.	Minor.
B	256	265	25	17	——	——
B♭	——	——	——	——	——	——
A	2	1	34	7	3	——
G♯	10	53	——	——	——	——
G	——	——	188	20	——	——
F♯	74	7	1	2	——	——
F	——	——	——	——	17	16
E	10	1	20	27	——	——
E♭	——	——	——	——	——	——
D♯	7	5	——	——	——	——
D	——	——	123	27	——	——
C♯	9	10	1	——	——	——
C	——	——	5	1	10	1

Besides the following chromatic intervals: [31]

Major mode.	{ 8 extreme sharp 5ths on C { 1 ——————— D { 1 extreme flat 7th —— G♯
Minor mode.	{ 4 extreme sharp 6ths on F { 4 extreme flat 7ths on C♯ { 3 ——————— G♯

It was thought best to exhibit a complete table of all the consonances which occurred in the 200 scores examined; although (Prop. II.) only the concords in the upper half of the table can be regarded in forming a system of temperament. For the more frequent consonances, this table may be regarded as founded on a sufficiently extensive induction to be tolerably accurate. For the more unfrequent chords, and especially for those which arise from unusual modulations, it expresses the chance of occurrence with very little accuracy; and it is doubtless the fact that a more extensive investigation would include some chords not found at all in this list. But it must be recollected, on the other hand, that the influence of these unusual chords on the resulting system of temperament would be insensible, could their chance of occurrence be determined with the greatest accuracy.

But none of the numbers in the foregoing table by any means expresses the chance that a given interval will occur, considering *all* the keys in which it is found. For example, the Vth CG on the tonic of the natural key, in music written on this key, is the one of most frequent occurrence, its chance being expressed by 1807; but in the key of two flats, it becomes the Vth on the supertonic, and its chance of occurrence is only as 197. Hence the problem can be completed only by finding a set of numbers which shall express, with some degree of accuracy, the relative frequency of different signatures.

An examination of 1600 scores, comprising four entire collections of music for the organ and voice, by the best European composers, besides many miscellaneous pieces, afforded the results in the following table:

[32]

TABLE III.

Signatures.	Major Mode.	Minor Mode.
4♯*s*	42	2
3♯*s*	95	6
2♯*s*	200	13
1♯	322	72
♮	176	121
1♭	180	97
2♭*s*	70	77
3♭*s*	116	8
4♭*s*	0	3
Ratio of their sums	1201 :	399

The chance of occurrence for any chord varies as the frequency of the key to which it belongs, and as the number belonging to the place which it holds, as referred to the tonic, in Table II., jointly. Hence the chance of its occurrence in all the keys in which it is found, is as the sum of the products of the numbers in Table III., each into such a number of Table II. as corresponds to its place in that key. To give a specimen of the manner in which this calculation is to be conducted, the numbers belonging to the major mode in the three first divisions of Table II. are first to be multiplied throughout by 176, which expresses the relative frequency of the major mode of the natural key. They are then to be multiplied throughout by 322, which expresses the frequency of the key of one sharp. But the first product, which expresses the frequency of the Vth on the tonic, now becomes GD, and must be added, not to the first, but to the fifth, in the last row of products. The product into 59, expressing the frequency of the Vth on the mediant, becomes BF♯, an interval not found among the essential chords of the natural key. In general, the products of the numbers in Table III. into those in Table II. are to be considered as belonging, not to the letters against which these multipliers stand, but to those which have the same position *with regard to* [33] *their successive tonics*, as these have with regard to C. Whenever an interval occurs, affected with a new flat or sharp, it is to be considered as the commencement of a new succession of products. The IIId C♯E♯, for example, does not occur at all till we come to the key of two sharps, and even then only in occasional modulations, corresponding to the IIId on B in the natural key, whose multiplier is 10. In the key of 3 sharps it becomes another accidental chord, answering to the IIId on E in the key of C, and consequently has 40 for its multiplier. It is only in the key of 6 sharps, that it becomes a constituent chord of the key; when if that key were ever used, it would correspond to the IIId GB on the dominant of the natural key.

After all the products have been taken and reduced to their proper places, in the manner exemplified above, a similar operation must be repeated with the numbers in the second column of Table III. and those in the second columns in the three first divisions of Table II.

The necessity of keeping the major, and its relative minor key, distinct, will be evident, when we consider that the several keys in the minor mode do not follow the same law of frequency as in the major; as is manifest from the observations in Schol. Prop. III. and as clearly appears from an inspection of Table III.

But in order to discover the relative frequency of the different chords on *every* account, the results of the two foregoing operations must be united. Now, as the numbers in the two columns of Table II. at a medium, are as 3 : 1, and those in Table III. are in the same ratio, although the factors are to each other in only the simple ratio of the relative frequency of the two modes, yet their products will, at a medium, be in the *duplicate* ratio of that frequency. Hence, to render the two sets of results homologous, so that those which correspond to the same interval may be properly added, to express the general chance of occurrence for that interval in all the major and minor keys in which it is found, this duplicate ratio must be reduced to a simple one, either by dividing the first, or by multiplying the last series of results, by 3. We will do the latter, as it will [34] give the ratios in the largest, and, of course, the most accurate terms. Then adding those results in each which belong to the same interval, and cutting off the three right hand figures, (expressing in the nearest small fractions those results which are under 1000) which will leave a set of ratios abundantly accurate for every purpose; the numbers constituting the final solution of the problem will stand as follows:

TABLE IV.

Bases.	Vths and 4ths.	IIIds and 6ths.	3ds and VIths.	Bases.	Vths and 4ths.	IIIds and 6ths.	3ds and VIths.
F♯	67	29	1072	B♯	——	——	4
F	639	924	66	B	221	135	1161
E♯	——	——	12	B♭	418	654	5
E	548	323	1151	A♯	——	——	29
E♭	265	363	½	A	870	568	1085
D♯	⅓	½	144	A♭	52	78	⅕
D	1166	943	569	G♯	5	4	365
D♭	1	6	——	G	1207	1197	567
C♯	25	12	581	F♯♯	——	——	¼
C	816	1131	180	G♭	——	½	——

Note. In this table, as well as the last, the Vths, IIIds, and 3ds are to be taken *above*, and the 4ths, 6ths, and VIths, their complements to the octave, *below* the corresponding degrees in the first column. And, in general, whenever the Vths, IIIds, and 3ds are hereafter treated as different classes of concords, each will be understood to include its complement to the octave and its compounds with octaves.

Scholium.

The foregoing table exhibits, with sufficient accuracy, the ratio of the whole number of times which the different chords would occur, were the 1600 scores, whose signatures were examined, actually played in succession, on the keys to which they are set, and with an instrument having distinct sounds for all the flats and sharps. Had the examination been more extensive, the results [35] might be relied on with greater assurance as accurate; but the general similarity, not only in the structure of different musical compositions, but in the comparative frequency of the different keys in different authors; is so great, that a more extensive examination was thought to be of little practical importance.

(*To be continued.*)

Art. II. *Review of an elementary Treatise on Mineralogy and Geology, being an introduction to the study of these sciences, and designed for the use of pupils; for persons attending lectures on these subjects; and as a companion for travellers in the United States of America—Illustrated by six plates. By* Parker Cleaveland, *Professor of Mathematics and Natural Philosophy, and Lecturer on Chemistry and Mineralogy in Bowdoin College, Member of the American Academy, and Corresponding Member of the Linnæan Society of New England.*

—— itum est in viscera terræ:
Quasque recondiderat, Stygiisque admoverat umbris,
Effodiuntur opes —— Ovid.

Boston, published by Cummings and Hilliard, No. 1, Cornhill. Printed by Hilliard & Metcalf, at the University Press, Cambridge, New England. 1816.

This work has been for some time before the public, and it has been more or less the subject of remark in our various journals. It is, however, so appropriate to the leading objects of *this* Journal, that we cannot consider ourselves as performing labours of supererogation while we consider the necessity, plan, and execution of the treatise of Professor Cleaveland.

An extensive cultivation of the physical sciences is peculiar to an advanced state of society, and evinces, in the country where they flourish, a highly improved state of the arts, and a great [36] degree of intelligence in the community. To this state of things we are now fast approximating. The ardent curiosity regarding these subjects, already enkindled in the public mind, the very respectable attainments in science which we have already made, and our rapidly augmenting means of information in books, instruments, collections, and teachers, afford ground for the happiest anticipations.

Those sciences which require no means for their investigation beyond books, teachers, and study—those which demand no physical demonstrations, no instruments of research, no material specimens: we mean those sciences which relate only to the intellectual and moral character of man, were early fostered, and, in a good degree, matured in this country. Hence, in theology, in ethics, in jurisprudence, and in civil policy, our advances were much earlier, and more worthy of respect, than in the sciences relating to material things. In some of these, it is true, we have made very considerable advances, especially in natural philosophy and the mathematics, and their applications to the arts; and this has been true, in some good degree, for very nearly a century. Natural history has been the most tardy in its growth, and no branch of it was, till within a few years, involved in such darkness as mineralogy. Notwithstanding the laudable efforts of a few gentlemen to excite some taste for these subjects, so little had been effected in forming collections, in kindling curiosity, and diffusing information, that only fifteen years since, it was a matter of extreme difficulty to obtain, *among ourselves*, even *the names* of the most common stones and minerals; and one might inquire earnestly, and long, before he could find any one to identify even *quartz*, *feldspar*, or *hornblende*, among the simple minerals; or *granite*, *porphyry*, or *trap*, among the rocks. *We speak from experience*, and well remember with what impatient, but almost despairing curiosity, we eyed the bleak, naked ridges, which impended over the valleys and plains that were the scenes of our youthful excursions. In vain did we doubt whether the glittering spangles of mica, and the still more alluring brilliancy of pyrites, gave assurance of the [37] existence of the precious metals in those substances; or whether the cutting of glass by the garnet, and by quartz, proved that these minerals were the diamond; but if they were not precious metals, and if they were not diamonds, we in vain inquired of our companions, and even of our teachers, what they were.

We do not forget that Dr. Adam Seybert, in Philadelphia; Dr. Samuel L. Mitchill, in New-York; and Dr. Benjamin Waterhouse, in Harvard University, began at an earlier period to enlighten the public on this subject; they began to form collections; Harvard received a select cabinet from France and England; and Mr. Smith, of Philadelphia, (although, returning from Europe fraught with scientific acquisitions, he perished tragically near his native shores,) left his collection to enrich the Museum of the American Philosophical Society.

Still, however, although individuals were enlightened, no serious impression was produced on the public mind; a few lights were indeed held out, but they were lights twinkling in an almost impervious gloom.

The return of the late Benjamin D. Perkins, and of the late Dr. A. Bruce, from Europe, in 1802 and 3, with their collections, then the most complete and beautiful that this country had ever seen; the return of Colonel Gibbs, in 1805, with his extensive and magnificent cabinet; his consequent excursions and researches into our mineralogy; the commencement, about this time, of courses of lectures on mineralogy, in several of our colleges, and of collections by them and by many individuals; the return of Mr. Maclure, in 1807; his Herculean labour in surveying the United States geologically, by personal examination; and the institution of the American Journal of Mineralogy, by Dr. Bruce, in 1810;—these are among the most prominent events, which, in the course of a few years, have totally changed the face of this science in the United States.

During the last ten years, it has been cultivated with great ardour, and with great success: many interesting discoveries in American mineralogy have been made; and this science, with its [38] sister science, Geology, is fast arresting the public attention. In such a state of things, books relating to mineralogy would of course be eagerly sought for.

No work, anterior to Kirwan, could be consulted by the student with much advantage, on account of the wonderful progress, which, within forty or fifty years, has been made in mineralogy. Even Kirwan, who performed a most important service to the science, was become, in some considerable degree, imperfect and obsolete; the German treatises, the fruitful fountains from which the science had flowed over Europe, were not translated; neither were those of the French; and this was the more to be regretted, because they had mellowed down the harshness and enriched the sterility of the German method of description, besides adding many interesting discoveries of their own. It is true we possessed the truly valuable treatise of Professor Jameson, the most complete in our language. But the expense of the work made it unattainable by most of our students, and the undeviating strictness with which the highly respectable author has adhered to the German mode of description, gave it an aspect somewhat repulsive to the minds of novices, who consulted no other book. We are, however, well aware of the value of this work, especially in the improved edition. It must, without doubt, be in the hands of every one who would be master of the science; but it is much better adapted to the purposes of proficients than of beginners.

The mineralogical articles dispersed through Aikin's Dictionary are exceedingly valuable; but, from the high price of the work, they are inaccessible to most persons.

The most recent of the French systems, that by Brongniart, seemed to combine nearly all the requisites that could be desired in an elementary treatise; and a translation of it would probably, ere this, have been given to the American public, had we not been led to expect the work of Professor Cleaveland, which, it was anticipated, would at least possess one important advantage over the work of Brongniart, and every other; it would exhibit, more or less extensively, *American* [39] *localities*, and give the leading features of our natural mineral associations.

Thus it appears[8] that the work of Professor Cleaveland was eminently needed; the science, at large, needed it; and to American mineralogists it was nearly indispensable. It appeared too at a very opportune moment. Had it come a few years sooner, it might not have found many readers. Now it is sustained by the prevailing curiosity, and diffused state of information regarding mineralogy; and, in turn, no cause could operate more effectually to cherish this curiosity, and to diffuse this information still more widely, than this book. Professor Cleaveland is therefore entitled to our thanks for undertaking this task; and, in this age of book-making, it is no small negative praise if an author be acquitted of *unnecessarily* adding to the already onerous mass of books.

With respect to the PLAN of this work, Professor Cleaveland has, with good judgment, availed himself of the excellencies of both the German and French schools.

Mr. Werner, of Fribourg, in some sense not only the founder of the modern German school of mineralogy, but almost of the science itself, is entitled to our lasting gratitude for his system of external characters, first published in 1774. In this admirable treatise he has combined precision and copiousness, so that exact ideas are attached to every part of the descriptive language, and every character is meant to be defined.

It is intended that a full description of a mineral upon this plan shall entirely exhaust the subject, and that although many properties may be found in common among different minerals, still every picture shall contain *peculiar* features, not to be found in any other. It would certainly appear, at first view, that this method must be perfect, and leave nothing farther to be desired. It has, however, been found in practice, that the full descriptions of the Wernerian writers are heavy and dry; they are redundant also, from the frequent repetition of similar properties; and [40] from not giving due prominence to those which are peculiar, and therefore distinctive, they frequently fail to leave a distinct impression of any thing on the mind, and thus, in the midst of what is called by the writers of this school a full *oryctognostic picture*, a student is sometimes absolutely bewildered.

Some of the modern French writers, availing themselves of Mr. Werner's very able delineation of the external characters of minerals, have selected such as are most important, most striking, distinctive, and interesting; and drawing a spirited and bold sketch, have left the minuter parts untouched: such a picture, although less perfect, often presents a stronger likeness, and more effectually arrests the attention.

This is the method of description which has been, as we think, *happily* adopted, to a great extent by Mr. Cleaveland.

Mr. Werner, availing himself of the similarities in the external appearance of minerals, has (excepting the metals) *arranged* them also upon this plan, without regard to their constitution; that is, *to their real nature*, or, at least, making this wholly subservient to the other: this has caused him, in some instances, to bring together things which are totally unlike in their nature, and, in other instances, to separate those which were entirely similar. Whatever may be said in favour of such a course, considered as a provisional one, while chemical analysis was in its infancy, the mind can never rest satisfied with any arrangement which contradicts the real nature of things; in a word, the composition of minerals is the only correct foundation for their classification. This classification has been adopted by several of the ablest modern French writers.

"It is believed," (says Professor Cleaveland, Preface, p. 7.) "that the more valuable parts of the two systems may be incorporated, or, in other words, that the peculiar descriptive language of the one may, in a certain degree, be united to the accurate and scientific arrangement of the other.

"This union of descriptive language and scientific arrangement has been effected with good success, by Brongniart, in his System of Mineralogy—an elementary work, which seems better adapted both to interest and instruct, than any which has hitherto appeared. The author of this [41] volume has, therefore, adopted the *general* plan of Brongniart, the more important parts of whose work are, of course, incorporated with this."

A happier model could not, in our opinion, be chosen; and we conceive that Professor Cleaveland is perfectly consistent, and perfectly perspicuous, when, adopting the chemical composition of minerals as the only proper foundation of arrangement, and, of course, rejecting the principle of Mr. Werner, which arranges them upon their external properties, he still adopts his *descriptive* language as far as it answers his purpose. For to elect a principle of arrangement, and to classify all the members of a system so as to give each its appropriate place, is obviously quite a different thing from describing each member, after its place in a system is ascertained. In doing the latter, characters may be drawn from any source which affords them.

In his "Introduction to the Study of Mineralogy," the author has given a view at once copious, condensed, and perspicuous, of all that is necessary to be learned previously to the study of particular minerals. He begins with definitions and general principles, which are laid down with clearness.

By way of engaging the attention to the study of this department of nature, he remarks:

"From a superficial view of minerals in their natural depositories, at or near the surface of the earth, it would hardly be expected that they could constitute the object of a distinct branch of science. Nothing appears farther removed from the influence of established principles and regular arrangement, than the mineral kingdom when observed in a cursory manner. But a closer inspection and more comprehensive view of the subject will convince us, that this portion of the works of nature is by no means destitute of the impress of the Deity. Indications of the same wisdom, power, and benevolence, which appear in the animal and vegetable kingdoms, are also clearly discernible in the mineral."

"It may also be remarked," continues the author, "that several arts and manufactures depend on mineralogy for their existence; and that improvements and discoveries in the latter cannot fail [42] of extending their beneficial effects to the aforementioned employments. In fine, the study of mineralogy, whether it be viewed as tending to increase individual wealth, to improve and multiply arts and manufactures, and thus promote the public good; or as affording a pleasant subject for scientific research, recommends itself to the attention of the citizen and scholar."

This introductory view of the importance and interest of the science cannot be charged with the fault of exaggeration, since it is most evident that neither civilization, refinement in arts, nor comfort, can exist where the properties of mineral substances are but imperfectly understood.

As regards this country, the argument admits of much amplification. The more our mineral treasures are explored, the more abundantly do they repay the research; and we trust that the period is not far distant, when we shall no longer ignorantly tread under our feet minerals of great curiosity and value, and import from other countries, at a great expense, what we, in many instances, possess abundantly at home.[9]

But to return to the plan of the author's work. Few persons, unacquainted with the science of mineralogy, would suspect that mere brute matter could exhibit many strong marks, capable of discrimination.

It may, however, be confidently affirmed, that there is no mineral which, if carefully studied, may not be distinguished by characters sufficiently decisive from every other mineral; an account of these characters ought, therefore, to precede every system of mineralogy. Professor Cleaveland has, with entire propriety, included them under the heads of crystallography, physical [43] and external characters, and chemical characters.

He has given a clear view of the Abbé Haüy's curious discoveries regarding the six primitive figures or solids which form the bases of all crystals—the three integrant particles or molecules which constitute the primitive forms, and of the theory by which it is shown how the immensely numerous and diversified secondary or actual forms arise out of these few elementary figures.

This is certainly one of the most singular and acute discoveries of our age. It is true, there is a difference of opinion among mineralogists as to the practical use of crystallography in the discrimination of minerals. Some dwell upon it with excessive minuteness, and others seem restless and impatient of its details. The truth seems to be, that those who understand it, derive from it (wherever it is applicable) the most satisfactory aid; and it requires only a moderate knowledge of geometry to understand its principal outlines. On the other hand, it is no doubt possible, in most instances, to dispense with its aid, and to discriminate minerals by their other properties.

Of the external and physical characters of Mr. Werner, Mr. Cleaveland has given a clear account, combining into the same view the fine discriminations of the French authors, particularly regarding refraction, phosphorescence, specific gravity, electricity, chatoyement, and magnetism. The same may be said of the chemical characters. We do not know a more satisfactory and able view of the characters of minerals than Professor Cleaveland has exhibited.

We would however ask, whether, in enumerating the kinds of lustre, the term *adamantine* should not be explained, as it is not understood by people in general, while the terms denoting the other kinds are *generally* intelligible; whether in the enumeration of imitative forms, *lenticular* and *acicular* should not rather be referred to the laws of crystallization; whether *reniform* and *mamillary* are synonymous; whether *sandstone*, as being a mere aggregate of *fragments*, is a good instance of the *granular* fracture; whether in its natural state (at least the [44] common ore of nickel) is *ever* magnetic, till *purified*, and whether cobalt is *ever* magnetic unless *impure*.

Professor Cleaveland's remarks on *fracture* are uncommonly discriminating and instructive, and would lead a learner to a just comprehension of this important point in the characters of minerals.

The section relating to the *chemical characters* is concise, and professedly proceeds upon the principle of selection. It might perhaps have been, to some extent, advantageously enlarged; although, it is true, the author refers us to the particular minerals for individual instances; still it might have been well to have illustrated the general principles by a few well-chosen instances, *e. g.* how, by the blowpipe, *galena* is distinguished from *sulphuret of antimony*; *carbonat of lead* from *sulphat of barytes*, or *carbonat of lime*; *garnet* from *titanium*; *plaster of Paris* from *soapstone*, &c.; and, among trials in the moist way, how by nitric acid and ammonia, *iron pyrites* is distinguished from *copper pyrites*; and how, by acids, *sulphat of lime* is known from *carbonat of lime*. As the acids are used principally for trials on the effervescence of carbonats, most of which form with sulphuric acid, insoluble compounds, we should doubt whether sulphuric acid is so advantageously employed as the nitric or muriatic, in such cases, on account of the clogging of the effervescence by the thick magena, produced by a recently precipitated and insoluble sulphat.

According to our experience, the nitric or muriatic acid, diluted with two or three parts of water, is most eligible.

With respect to the blowpipe: it is *a convenience* to have a mouth-piece of wood, or ivory, joined to a tube of metal, as Mr. Cleaveland recommends; and some authors direct to have the tube attached to a hollow ball, for the sake of condensing the moisture of the breath; but every thing which adds to the expense and complication of the instrument will tend to discourage its use; we have never found any difficulty in performing every important experiment with the common goldsmith's brass blowpipe; and are confident, that, after the learner has acquired the art, or *knack*, of propelling a continued stream of air from his mouth, by means of the muscles of the lips and cheeks, while his respiration proceeds without embarrassment through the nostrils, [45] he will need no other instrument than the common blowpipe. Indeed it is a truly admirable instrument, instantly giving us the effect of very powerful furnaces, the heat being entirely under command, the subject of operation and all the changes in full view, and the expense and bulk of the instrument being such that every one may possess it, and carry it about his person.

The chapter on the principles of arrangement is worthy of all praise. This difficult subject is here discussed with such clearness, comprehensiveness, and candour, as prove the author to be completely master of his subject; and we are persuaded, that, on this topic, no author can be studied with more advantage. We forbear to extract, because the whole should be attentively perused in connexion, and scarcely admits of abridgement. We entirely agree with Professor Cleaveland, as we have already said, that the chemical composition of minerals is the only just foundation of their arrangement; that next in importance is the crystalline structure, including a knowledge of the primitive form, and integrant molecule; and last and least important, *in fixing the arrangement*, are the external characters: these last should be only provisionally employed, where the two first are not ascertained, or the second is not applicable. When the arrangement is once made, we *may*, however, and we commonly *shall*, in *describing* minerals, pursue precisely the reverse order; the external characters will usually be mentioned first, the crystalline characters next, and the chemical last of all. In description, the external characters are often the most valuable; if judiciously selected and arranged, they will always prove of the most essential service, and can rarely be entirely dispensed with.

With regard to the nomenclature of minerals, we feelingly unite with Professor Cleaveland in deploring the oppressive redundancy of synonymes. Few minerals have only one name, and usually they have several. With Count Bournon we agree, that the discoverer of a mineral has the exclusive right of naming it, and that the name once given should not be changed without the most cogent reasons. What then shall we say of the Abbé Haüy, of whom, whether we speak of his [46] genius, his learning, his acuteness, his discoveries, his candour, and love of truth, or his universally amiable and venerable character, we can never think without sentiments of the highest respect and admiration? More than any modern writer he has added to the list of synonymes, often exchanging a very good name, derived perhaps from the locality or discoverer of a mineral, for one professedly significant, but connected with its subject by a chain of thought so slight, that considerable knowledge of Greek etymology, and still more explanation, is necessary to comprehend the connexion; and thus, after all, it amounts, with respect to most readers, only to the exchange of one arbitrary name for another. What advantage, for instance, has *grammatite*, alluding to a line often obscure, and still oftener wholly invisible, over the good old name *tremolite*, which always reminds us of an interesting locality; how is *pyroxene* better than *augite*, *amphibole* than *hornblende*, *amphigene* than *leucite*, or *disthene* than *sappar*. Some of the Abbé Haüy's names are, however, very happily chosen, especially where new discriminations were to be established, or errors corrected, or even a redundant crop of synonymes to be superseded by a better name. *Epidote* is an instance of the latter, and the new divisions of the old *zeolite family* into four species, *mesotype*, *stilbite*, *analcime*, and *chabasie*, afford a happy instance of the former. It were much to be wished, that by the common consent of mineralogists, one nomenclature should be universally adopted: for its uniformity is of much more importance than its nature.

In expressing our approbation of the principles of arrangement adopted by Professor Cleaveland, we have of course espoused those of his tabular view, which is perhaps as nearly as the state of science will admit, erected upon a chemical basis, like that of Brongniart, to which it bears a close resemblance. Some of the subordinate parts, we could have wished had been arranged in a manner somewhat different. In the genus lime, it appears to us better to describe the species carbonat first; because, being very abundant, and its characters clear, it forms a convenient point of departure and standard of comparison, in describing the other species which [47] have lime for their basis, and some of which are comparatively rare. The same remark we would make upon quartz, and its concomitant, pure silicious stones. There appears to us a high advantage in making these minerals clearly known first, before we proceed to those which are much more rare, and especially which are much harder, and possess the characters of gems. For example, if a learner has become acquainted with quartz, chalcedony, flint, opal, chrysoprase, and jasper, he will much more easily comprehend the superior hardness, &c. and different composition of topaz, sapphire, spinelleruby, chrysoberyl, and zircon, which we should much prefer to see occupying a later, than the first place in a tabular arrangement; and, although topaz, by containing fluoric acid, appears to be in some measure assimilated to saline minerals, it is in its characters so very diverse from the earthy salts, that we have fair reason to conclude that the fluoric acid does not stamp the character; and, as it bears so close a resemblance to the ruby and sapphire, which evidently derive their principal characters from the argillaceous earth, we perhaps ought to infer that this (the topaz,) does so too. Indeed Professor Cleaveland has sufficiently implied his own opinion, by giving these minerals a juxtaposition in his table, although the same reasons which induced the placing of the topaz next to the earthy salts, could not have justified the placing of the sapphire there. On these points we are not, however, strenuous; they are of more importance if the work be used as a text-book for lectures, than as a private companion. With respect to the *completeness* of Professor Cleaveland's tabular view, we have carefully compared it with the third edition of Jameson's mineralogy; and although a few new species, or sub-species, and varieties have been added in this last edition, they are in general of so little importance, that Professor Cleaveland's work cannot be considered as materially deficient; and the few cases in which it is so, are much more than made up by his entirely new and instructive views of American mineralogy, to which no parallel is to be found in any other book, and which give it peculiar interest to the American, and even to the European, [48] reader.

In another edition, (which we cannot doubt will speedily be called for,) he will of course add whatever is omitted in this, and we should be gratified to see a good article on the subject of the ærolites or stones which have fallen from the atmosphere. This subject is one, in our view, of high interest; and although *in strictness* it may not claim a place in a tabular view of minerals, (we must confess, however, that we see no important obstacle to its being treated of under the head of native iron,) there can be no objection to its being placed in an appendix. The fall of stones from the atmosphere is the most curious and mysterious fact in natural history.

It may seem perhaps too trivial to remark, that the annexation of numbers, referring to the pages, would be a serious addition to the utility of the tabular view. Very few inadvertencies have been observed—the following may be mentioned: *Amenia*, in the State of New-York, is printed (by a typographical error we presume) Armenia; and *Menechan*, where the menechanite is found, is mentioned as occurring in Scotland, but it is in Cornwall.

Authors seem agreed that the black-lead ore is an altered carbonat, but they seem not to have been so well agreed as to the nature of the blue-lead ore. In the cabinet of Colonel Gibbs, there are specimens which appear satisfactorily to illustrate both these subjects. The black-lead is by the blowpipe alone reducible to metallic lead; there is one specimen in the cabinet referred to, which is blackened on what appears to have been the under side, and seemingly by the contact of sulphuretted hydrogen gas; that which was probably the upper part remains unaltered, and is beautiful white carbonat of lead; this appearance is the more striking, because the piece is large and full of interstices, by which the gas appears to have passed through. The blue ore is in large six-sided prisms of a dark blue or almost black colour; where the prisms are broken across, they present an unequal appearance; sometimes they are *invested*; and sometimes slightly, and at other times deeply, *penetrated* by sulphuret of lead, having the usual brilliant foliated fracture. [49]
The part which looks like sulphuret of lead is easily reducible by the blowpipe, but not the whole crystal, as authors appear to imply; for if that part of the crystal which does not present the appearance of galena is heated by the blowpipe flame, it is not reduced, but congeals into the garnet dodecahedron, with its colour unaltered: these crystals are therefore phosphat of lead, and they appear to be either an original mixture of phosphat and sulphuret of lead, or the phosphat has somehow in part given up its phosphoric acid, and assumed in its stead sulphur, perhaps from the decomposition of sulphuretted hydrogen.

Professor Cleaveland will, of course, add new localities, even foreign ones, where they are interesting, and domestic ones, where they are well authenticated. Among the former, we trust he will mention the lake of sulphuric acid contained in the crater of Mount Idienne, in the Province of Bagnia Vangni, in the eastern part of Java, and also the river of sulphuric acid which flows from it and kills animals, scorches vegetation, and corrodes the stones.[10] Among American localities, we beg leave to mention violet fluor spar, abundant and very handsome, near Shawnee Town, on the Ohio, in the Illinois Territory, and galena, of which this fluor is the gangue;—sulphat of magnesia, perfectly crystallized, in masses composed of delicate white prisms, in a cave in the Indiana Territory, not very remote from Louisville, in Kentucky; it is said to be so abundant that the inhabitants carry it away by the wagon load;—pulverulent carbonat of magnesia, apparently pure, found by Mr. Pierce at Hoboken, in serpentine, where the hydrate of magnesia was found;—chabasie, agates, chalcedony, amethyst, and analcime, at Deerfield, by Mr. E. Hitchcock;—agates in abundance at East-Haven, near New-Haven, in secondary greenstone, like the above-named minerals at Deerfield;—saline springs, covered with petroleum, and emitting large volumes of inflammable gases, numerous in New-Connecticut, south of Lake Erie; —magnetical pyrites, abundant in the bismuth vein, at Trumbull, Connecticut:—very brilliant fine- [50]
grained micaceous iron, in large masses near Bellows' Falls; yellow foliated blende, in Berlin, Connecticut, and near Hamilton College—the latter discovered by Professor Noyes; it is in veins in compact limestone;—red oxid of titanium, often geniculated, at Leyden, in Massachusetts, discovered by Mr. E. Hitchcock;—red oxid of titanium, in very large crystals and geniculated, imbedded in micaceous schistus, at Oxford, 20 miles north from New-Haven;—silicious petrifactions of wood, abundant in the island of Antigua, recently brought by Mr. Pelatiah Perit, of New-York;—sulphuret of molybdena, at Pettipaug, and at East-Haddam, Connecticut;—prehnite abundant and beautiful, in secondary greenstone, at Woodbury, 24 miles north of New-Haven, discovered by Mr. Elijah Baldwin;—black oxid of manganese, in great abundance, and of an excellent quality, near Bennington, Vermont, and plumose mica, in a very fine graphic granite, in a hill two miles north of Watertown, Connecticut.

The introduction to the Study of Geology, deserves a more extended series of remarks than it would now be proper to make, after so full a consideration of the previous parts of the work.

Professor Jameson's elaborate exposition of the Wernerian system, is too full, and too much devoted to a particular system, for beginners: the sketches of geology contained in the systems of Chemistry by Murray and Thomson, and in Phillips's mineralogy, are too limited, although useful: the excellent account of the Wernerian system, contained in an Appendix to Brochant's Mineralogy, has, we believe, never been translated; and we need not say that Professor Playfair's illustrations of the Huttonian Theory, De Luc's Geology, and Cuvier's Geology, are not well adapted to the purposes of a beginner; neither is Delametherie's, nor has it been translated. An introduction to geology was, therefore, hardly less needed than one to mineralogy. Professor Cleaveland has performed this difficult duty with great ability, and has brought this interesting branch of science fairly within the reach of our students.

Although adhering substantially to the Wernerian arrangement of rocks, he has, so to speak, blended Werner's three classes of primitive, transition, and secondary rocks, into one class; and [51]
where the same rock occurs in all the three classes, or in two of them, he mentions it in giving the history of the particular rock. This method simplifies the subject very much to the apprehensions of a learner. A rigid Wernerian would probably revolt at it, but the distinctions of Mr. Werner may still be pointed out, and, we should think, ought to be, at least by all teachers.

In Mr. Cleaveland's account of the trap rocks, we should almost imagine that some typographical error had crept into the following paragraph:

"But in modern geological inquiries, the word trap is usually employed to designate a *simple* *mineral*, composed of hornblende nearly or quite pure, and also those aggregates in which *hornblende* predominates. Hence, the *presence* of hornblende, as a predominating ingredient, characterizes those MINERALS to which most geologists apply the name *trap*."

Now, it is not accordant with our apprehensions that trap is ever at the present time employed to designate a *simple mineral*, nor has Professor Cleaveland himself used it in his tabular view, or in his description of simple minerals. In our view, it is the *classical* word of modern geology, to designate that description of rocks in which hornblende predominates, and perhaps a few others of minor importance usually associated with them. It is true, a rock composed of pure hornblende may be called trap, but it is not true, *vice versa*, that this rock, considered in its character of a simple mineral, is called trap. If our views are correct, the section which is headed *trap* or *hornblende*, should be *trap* or *hornblende rocks*, and greenstone should come in as a subdivision, and not form a distinct section. With these alterations, and with the substitution of rock in the *first*, and rocks in the *second* instance, in the paragraph above quoted, instead of *mineral* and *minerals*, we apprehend the view of this family of rocks would be much more clear, and a degree of confusion, which learners now experience from the paragraph, would be prevented. If we are wrong, we are sure Professor Cleaveland will pardon us; if right, his candour will readily admit the correction.

As to the manner in which the work of Professor Cleaveland is executed, the remarks which we already made, have in a good degree anticipated this head. [52]

We cannot, however, dismiss the subject without adding that, in our opinion, this work does honour to our country, and will greatly promote the knowledge of mineralogy and geology, besides aiding in the great work of disseminating a taste for science generally. Our views of the plan we have already detailed. The manner of execution is masterly. Discrimination, perspicuity, judicious selection of characters and facts, and a style chaste, manly, and comprehensive, are among the characteristics of Professor Cleaveland's performance. It has brought within the reach of the American student the excellencies of Kirwan, Jameson, Haüy, Brochant, Brongniart, and Werner; and we are not ashamed to have this work compared with their productions. In our opinion Professor Cleaveland's work ought to be introduced into all our schools of mineralogy, and to be the travelling companion of every American mineralogist.

We trust that all cultivators of mineralogy and geology in this country, will willingly aid Professor Cleaveland in enlarging his list of American localities for a second edition; and we hope that he will repay them, at a future day, by giving us a distinct treatise on geology, with as particular a delineation as possible of the geological relations of the great North American formations. Mr. Maclure has, with great ability, sketched the outline; but much labour is still needed in filling up the detail.

ART. III. *New Locality of Fluor Spar, or Fluat of Lime and of Galena, or Sulphuret of Lead.*

Mr. Joseph Baldwin, formerly of Connecticut, now residing near Shawnee Town, in the Illinois Territory, has given us some interesting specimens of fluor spar. They are found not far from Shawnee Town, on the banks of the Ohio; and a few miles below where the Wabash joins the [53] Ohio. The fluor forms the gangue of a lead vein, and we have pieces in which the lead and fluor are intimately blended. The lead ore is the common galena, or sulphuret, with a broad, foliated, or laminated fracture, and a high degree of metallic splendour. We reduced it to the metallic state, and it yielded a large product of very soft lead. On dissolving it in nitric acid, and applying the muriatic acid till precipitation ceased, the precipitate formed was *all redissolved* by boiling water; nor, when submitted to cupellation did the lead leave any thing upon the cupel. We, therefore, conclude that it contained no appreciable quantity of silver. It is said to be very abundant at Shawnee Town.

The fluor spar is very beautiful. Its colours, chiefly, very deep purple and violet; but still highly translucent; one specimen was entirely limpid. Both kinds, when thrown in coarse powder, on a red-hot shovel, in a dark place, phosphoresced, and the violet specimens in a very striking manner. Of the violet kind, we have a specimen nearly as large as a man's fist, which is perfectly pure and sound, and appears to have been a single crystal; the natural faces and angles were unfortunately obliterated by grinding on a common grindstone. We have others which are decidedly crystals of perfect regularity; cubes, and passages between the cube and octahedron. In some of the specimens, the disposition of colours, and the transmission of light is such as to show very clearly that the octahedron lies in the centre, as the nucleus or primitive form.

The size and beauty of the specimens, and the abundance of this mineral near Shawnee Town, (provided there is no mistake in the case) clearly entitle this to be considered as the most interesting American locality of this beautiful mineral. Measures have been taken to investigate the subject more fully, and to obtain a supply of specimens.

Quartz crystals appear to abound at the same place, besides various other minerals.

ART. IV. *Carbonate of Magnesia, and very uncommon Amianthus, discovered near New-York.—Extract of a Letter from Mr. James Pierce to the Editor.* [54]

New-York, May 18, 1818.

DEAR SIR,

I forward you specimens of straw and rose-coloured amianthus I recently met with on Staten-Island, which I detached, in strips, from a rock; it not appearing, as is usual, in veins. It breaks up like flax, and may be spun and wove without the aid of moisture; and in respect to tenacity, flexibility, and length of fibre, it may be considered the best found in this country, and perhaps equal to any hitherto discovered. Staten-Island exhibits many minerals worthy of examination. I subjoin, as requested, the following geological description, &c.

Hoboken, where I discovered native carbonate of magnesia, is situated opposite the city of New-York, on the western or New-Jersey bank of the Hudson. It is a primitive, insulated elevation, with a nucleus of serpentine; the ground gradually descends in every direction except on the river side, where mural precipices of serpentine rock are observed, extending about 100 rods parallel with the water, and elevated from 60 to 100 feet above its level. The carbonate of magnesia I found in horizontal veins of nearly two inches in breadth, and of unknown depth, in a midway region of this serpentine ledge; I extracted a considerable quantity with a spoon. When first taken out it was soft, white, and very slightly adhesive, from a little moisture; but, when dry, fell to powder without friction. The nature of the mineral I immediately conjectured, and treated it with diluted sulphuric acid, in which it entirely dissolved with effervescence, forming a bitter fluid, and leaving no sediment. Upon evaporation, well-defined crystals of Epsom salts were formed. It differs little from the manufactured carbonate of magnesia of the shops; but is rather a super than a sub-carbonate. It has been analyzed by Professor Mitchill, who found it exclusively [55] composed of magnesia and carbonic acid. Carbonates of magnesia, hitherto discovered, have been, I believe, found impure, and in a state of rock, requiring chemical process to render them serviceable; this is, perhaps, fit for immediate use. When I first mentioned the discovery to mineralogists, they were incredulous, supposing it did not natively exist in this state, but I convinced them by uniting it with sulphuric acid.

REMARKS.

The specimen of amianthus, referred to in Mr. Pierce's communication, is uncommon. The fibres measure from 12 to 15 inches in length, and are as soft and flexible as fine human hair.

It will be remembered, that in the rocks at Hoboken, Dr. Bruce discovered the hydrate of magnesia, or magnesia combined with nothing but water, in the proportion of about 70 per cent. of magnesia. This discovery gave a new and interesting species to mineralogy; it is now admitted in the systematical works on mineralogy.

Mr. Pierce's discovery is not less interesting; and we presume he will be deemed correct in the opinion, that pure native carbonate of magnesia has not been discovered before. The serpentine of Hoboken, then, is memorable for affording these two new species.

Art. V. *Native Copper.*

In Bruce's Journal, (Vol. I. p. 149.) mention is made of a remarkable piece of native copper, found near New-Haven many years ago, and weighing about 90lbs.

We have now to add, (and the fact is, indeed, mentioned in Cleaveland's Mineralogy,) that another piece has been recently found half a mile west of the Hartford turnpike road, opposite the town of Wallingford, and twelve miles from New-Haven. It was turned up in ploughing to repair a road. The country is of the secondary trap formation, and the rocks, at the particular [56] place, are the old red sandstone of Werner, which here occupies the plains, and runs under the trap. The piece weighs almost six pounds; it is fine virgin copper, with rudiments of large octahedral crystals of native copper upon its surface, which is more or less incrusted with green carbonate of copper and ruby oxid, very much resembling that of Cornwall: the ruby oxid is particularly remarkable in the cavities of the piece.

As it was found within three or four miles of the place where the large piece of ninety pounds weight was discovered, and as copper is known to exist in many places in these hills, the facts should be kept in view, and may lead to something of importance.

Art. VI. *Petrified Wood from Antigua.*

The mineralogy and geology of the West-India islands has been, as yet, but little explored. The scientific world has, however, been favoured with some interesting articles from the pen of Dr. Nugent; and we are informed that he has described also the geology of the island of Antigua. We have recently become acquainted with one interesting production of this island, and without waiting for Dr. Nugent's account, (which we believe has not yet reached this country) we shall lay it before our readers.

We are under obligations to Mr. Pelatiah Perit, of New-York, for a collection of specimens of silicious petrifactions of wood from Antigua. Their characters are indubitable; the distinct ligneous layers corresponding with the annual growth, the medullary prolongations, the knots formed by branches, the cracks and the bark, are all distinctly visible. Some of the pieces are ponderous portions of large trees.

As to the mineralizing matter, it is evidently silicious, and the specimens are principally the holzstein of Werner; crystals of quartz are apparent in the cavities; some parts are agatized, and [57] veins of chalcedony occasionally pervade the fissures: they are not impressible by steel, and give fire with it. According to the information of Mr. Perit, they are scattered over the surface of the Island of Antigua, with a profusion hardly less than that which Horneman observed of the same mineral during his travels over the eastern part of the great African desert.

It is much to be wished that our numerous intelligent navigators and travelling merchants would, in imitation of this and of a similar example, mentioned below, bestow some share of their attention on the natural productions of the countries which they visit. In this way they might, on their return, render very essential services to the science of their own country.

Art. VII. *Porcelain and Porcelain Clays.*

Through the kind offices of a friend, we have been furnished, from one of the great porcelain manufactories in the vicinity of Paris, with a series of specimens, to illustrate the elegant art of fabricating porcelain. The specimens begin with the raw materials, and exhibit them in all their principal stages of advancement up to the perfect vessel, including the materials for the glazing, and the colours for the painting, and the application of both. At the request of the manufacturer, through whose liberality we were indulged with this gratification, we transmitted to Paris various specimens of American porcelain clays. This gentleman has caused them to be subjected to trials in the porcelain furnaces, and he finds that some of them are equal to the French porcelain clays, and some superior. As our specimens were all labelled with the names of the places, in this country, from which they were obtained, we hope soon to learn where to look for porcelain clays, equal or superior to those celebrated ones from which the superb French porcelain is manufactured.

As this subject is one of much practical importance to the rising arts of this country, and as [58] much interest has been excited in Paris concerning our porcelain clays, we should feel greatly obliged by the transmission to us of any specimens of American porcelain clays, with memoranda of the place, the quantity, the depth at which obtained, the difficulty of obtaining, and, generally, all the peculiar circumstances. We will take care that their value shall be ascertained, if they appear promising, and a proper return shall be made to the proprietor.

To those of our readers who may not be familiar with this subject, we would however take the liberty to remark, that porcelain clays generally arise from the decomposition of granite, and particularly of that kind which is denominated graphic granite, and which abounds with feldspar. It is, therefore, in the primitive countries that we are chiefly to expect them—such as New-England, and part of the high country of the middle and southern states.

It should be observed, that if a clay, otherwise apparently good, burns red, it contains iron, and is unfit for porcelain; although it may serve well enough for more common and coarse earthen ware.

Art. VIII. *Native Sulphur from Java.*

Through the kindness of Mr. I. Huntington, recently returned from Java, we have received from that Island some fine specimens of native sulphur. They are very pure, of an orange yellow, slightly shaded with white, and occasionally with red; some of the cavities are lined with delicate crystals. What gives them particular interest is, that they are believed to be from that "large, and now nearly extinct, volcano, about sixty miles from the town of Batavia, at the bottom of which (of the crater) lie large quantities of native sulphur, even many hundred tons." It is in the crater of this volcano that the famous lake of sulphuric acid exists, and from which it flows down the mountain, and through the country below, a river of the same acid. (See Tilloch's Phil. Mag. Vol. [59] XLII. p. 182.) It is a most curious phenomenon, and we believe entirely without a parallel. Another river, called the White River, unites with this some miles below its origin: this river, which is so called from the turbidness of its waters, its salutary to men and animals; fishes live in it, and vegetation is nourished by its waters; but after the junction it becomes clear; the acid dissolving the earthy particles which discoloured it, and it now becomes fatal to living beings: kills the fish, destroys the vegetation, and corrodes the stones in its channel. This remarkable river flows from Mount Idienne, in the province of Bagnia Vangni, in the eastern part of Java.

Art. IX. *Productions of Wier's Cave, in Virginia.*

We are indebted to the Reverend Elias Cornelius, and to Mr. John H. Kain, for a collection of the calcareous incrustations of Wier's Cave, in Virginia.

The stalactites, and stalagmites, and various incrustations, are of uncommon size and beauty. Some of the stalactites have a delicate whiteness, and a brilliancy arising from their crystallized structure, which, with the regularity of their forms, give them a fair title to rank with those of the famous caverns in the Peak of Derbyshire, in the island of Antiparos, &c.

In these stalactites, the structure is most remarkably distinct, both in the fibrous and concentric lamellar form. In this collection were observed many forms of the crystallized hard carbonates of lime, of Count Bournon.

For a description of the cavern from which these specimens came, we refer to the succeeding memoir, by Mr. Kain.

Art. X. *Remarks on the Mineralogy and Geology of the Northwestern part of the State of Virginia, and the Eastern part of the State of Tennessee.* By Mr. John H. Kain, of Tennessee. [60]

The most prominent as well as the most beautiful feature of this country, is that succession of mountain and valley, ridge and vale, which we meet with in traversing its surface. The grand range of Alleghany mountains enters Virginia about the 39th degree of north latitude; and, pursuing a southwestern course, spreads out upon the east end of Tennessee, and terminates near the southern boundary line of that state, in the Alabama territory; and about the 34th parallel of north latitude. In this view are included the Blue Mountains, the North Mountains, the Allegheny, (properly so called) the Cumberland, Clinch, Iron, and Smoky mountains, together with a variety of smaller mountains, spurs, and ridges, all running parallel to each other, from the northeast to the southwest; and all, I believe I may say, covered with forests, and presenting to the eye of the naturalist a most interesting field for speculation and improvement.

With a few exceptions, the geologist meets with none of those remarkable appearances which indicate the changes and convulsions which have been wrought by time, the great enemy of nature. Occasionally we are presented with a view of a sublime precipice, formed by a section which a river appears to have made for itself through an opposing mountain; and the large masses of ruins, which lie scattered around such a place, seem, to the imagination of the solitary traveller, the historical records of commotions, awful even in retrospect. Most commonly, however, the mountains seem to have lain for ages in undisturbed repose; and the streams of water, when they have crossed them, have sought an easy passage through the ravines, which do not so often divide a mountain, or ridge, at right angles, as wind between the ends of two opposing spurs, which pass each other, gradually declining into the champaign country at their [61]
mutual base. Through this whole extent of country we rarely meet with any remarkable falls of water; the obvious reason of which is, that the rocks are so soft that they are easily worn down to the level of the beds of rivers. But shoals, or shallows, are frequent, and are formed by beds of rounded sandstone, spread out into a broad base, over which the water often rushes with no small violence and noise.

The mountains are generally, though not always, sterile, and produce nothing but forest trees; but the valleys are, with hardly an exception, rich, and productive of every variety of "grass and herb yielding seed, and fruit-tree yielding fruit." Nor are they less favoured in the mineral kingdom; possessing the greatest abundance of all the most useful and necessary minerals, of which we shall now proceed to speak in order.

All the country included under the boundaries mentioned above, with the exception of some primitive ranges of mountains on the southeastern side, is apparently *transition*. This, it will be seen by a reference to Mr. Maclure's excellent map, will extend the boundary of his transition class considerably farther northwest, and make it include Cumberland Mountain and all East Tennessee. This would be evident from comparing the northwestern part of Virginia, which Mr. Maclure has included in his transition tract with all East Tennessee. Every mineralogist must observe the identity of the minerals of the two countries as well as that of their stratification and general formation. The limestone in the valleys, and the sandstone on the mountains, lie in strata which make an angle of from 25 to 45 degrees with the horizon. The limestone bears the impressions of shells, but rarely, if ever, of vegetables, and contains beds of hornstone, but not of flint, or what can properly be called flint.

The rock which lies in the lowest valleys, and often rises into pretty high hills, and is seen forming bluffs on the banks of the rivers, is *limestone*: it is of a dark blue, approaching to a gray, as it is exposed to the air, and often appearing quite white. Its fracture is compact in one direction; in another it is more or less slaty in its structure. It is interspersed with veins of the [62]
crystallized carbonate of lime, more or less perfect, and of a pure but opaque white. Another variety of this limestone, not so abundant, is that which is white and red, having the white and red spots intimately mingled. Its structure is similar to the other kind.

Lying in beds of this limestone, parallel to, and imbedded in, its strata, is a stone, which, from its globular form, its hardness, and its colour, has been usually mistaken for flint. On comparing it with the flint of chalk-beds, we find it much less translucent, its colour darker, and its hues duller; and its rough and irregular fracture, compared with the easy, smooth, and conchoidal cleavage of the true flint, decides it to be hornstone. It is found also forming considerable distinct beds on the hills; and is seen in detached pieces, and irregular pebbles, covering many of the ridges.

Alternating with the beds of limestone, and possessing the same formation, is a soft *clay slate*. *Soapstone* is found in it.

As soon as we ascend the mountains, we meet with a slaty sand-stone of various compactness, as it possesses more or less iron, often forming an excellent iron ore. A variety of this iron ore has been lately turned to a good use, in the manufacture of a red paint, near Knoxville, Tennessee. Different varieties of this sandstone possess different qualities. It is converted by the inhabitants into millstones, grindstones, and whetstones. Interspersed among the sandstone of the mountains we often find very beautiful and interesting specimens of hornstones, assuming a resemblance to all the silicious stones, from the chalcedony to the jasper. In this extensive range of mountains, many other minerals exist, of which we shall treat more particularly hereafter. The limestone, slate, and sandstone, as far as the writer's knowledge extends, so to speak, *form the country*; the limestone and clay slate dipping under the sandstone. Gypsum, coal, sulphate of barytes, &c. are found in these, and we shall now speak of their localities.

Gypsum.—This valuable mineral production exists in Washington County, Virginia, 20 miles north of Abingdon, in the vicinity of Saltville. It is similar, in every respect, to the plaster of Nova [63] Scotia, and devoted by the farmers of that part of Virginia, and Tennessee, to similar purposes.

Coal is said to exist in immense quantities in the Cumberland Mountain. A bed of it is wrought near Knoxville, Tennessee. It is of an excellent quality; but wood is so abundant that it is used only in forges.

Sulphate of Barytes.—This mineral is found in Bottetourt County, Virginia, near Fincastle; and in Sevier County, Tennessee.

Hard Carbonates of Lime.—Stalactitical concretions abound in all the caves so often described as existing in this country. Those of Virginia are more perfectly crystallized than those of Tennessee. Under the head of *hard carbonates* should be mentioned an extensive bed or vein in Montgomery County in the State of Virginia, near the seat of Colonel Hancock. It appears to have been formed in a chasm, in the common limestone of the country, by a calcareous deposition which resembles, exactly, in all its characters, the calcareous concretions which are found forming in the caves of the country. The whole bed may, in fact, be regarded as a cave which has been filled up in the progress of time, by this curious process. Its width is various, from two feet to ten, or more, extending along the side of a very steep ridge, for at least 50 yards, and it is said to be continued seven miles farther.

The silicious carbonate of lime may be worth distinguishing from the common limestone. It is found in a bed near Colonel Hancock's, and was supposed to be gypsum. It phosphoresces beautifully; it is white, and confusedly crystalline in its structure, and much harder than the common limestone. Indeed the limestone generally, on the east of the Alleghany, is somewhat harder than that on the west.

Lead.—There are several localities of this mineral. A mine of it is wrought near New River, 15 miles from Wythe, Virginia. Another locality of the ore of lead is said to have been discovered in Granger County, Tennessee, on land belonging to General Cocke. It exists also, very near the surface, on the plantation of the Rev. Mr. Craighead, near Nashville; which, however, is out of our boundary.

Other metallic ores are said to have been found among these mountains, and particularly those [64] of gold and silver; but the accounts are vague and uncertain, and not to be credited.

The numerous *Caves* of this country present attractions to every, the least curious, traveller; and, in an eminent degree, to the mineralogist. They are crevices, or large chasms, probably worn in the rocks by the passage of water. This will, at first view, perhaps appear a bold assertion; but if it be recollected that they occur only in limestone, which is a soft rock, and (under certain circumstances,) soluble in water; that the rocks bear every mark of having been worn by water; and that streams of water are always found in them, it will not appear an improbable hypothesis. It is by no means difficult to believe that a stream, after having worn such a chasm as a cave presents, in the solid rock, may have found another channel; and, forsaking the old, have left room for nature to display some of her most beautiful works. A description of one of these caves will be a description of all; and we shall select *Wier's Cave*, in Rockingham County, Virginia, as it is the most curious of any with which we are acquainted.

The entrance of the cave is narrow and difficult. When the cave was first discovered, the passage into it was impeded by stalactites, which had formed perpendicular columns across it; but these are now removed. As we advance, our course is at first horizontal, but we soon descend fifteen or twenty feet by a ladder, and find ourselves in a large echoing cavern. Stalactites of a silvery whiteness are suspended from above, and pillars of stalagmites are rising around us. Ledges of rocks form our floor, and the uneven walls are incrusted over with a beautiful brown spar, which is sometimes suspended from the canopy in thin, shining, and translucent sheets. In passing on over the rugged rock of our pathway, our attention is divided between a care for our safety, and an admiration of the surrounding wonders.

Proceeding on through a narrower crevice in the rocks, we are soon introduced into other apartments, differing in shape and size from the first, but resembling it in the irregularity of its [65] walls, floor, and covering, and in the calcareous incrustations and concretions, which, assuming a thousand fantastic shapes, and displaying a sparkling lustre, the more vivid as the light is stronger, give to this whole grotto the power of charming every beholder.

The cave is a mile and a half in extent, and extremely irregular in its course and shape. Its perpendicular height varies from three to forty feet, and its breadth from two to thirty. Its dividing branches are numerous, forming a great variety of apartments. The blue limestone appears frequently enough to satisfy us that it is the groundwork of the whole; but it is almost every where covered with incrustations of the hard carbonates. These hang from the arched vault above in clusters, and often reach the ground, forming massive columns. Stalagmites again rise from the floor like so many statues; the irregular sides of the ledges of rocks are often incrusted over with white crystals of the carbonate of lime, and have the appearance of banks of salt: at times we seem to walk on diamond pavements; again our footway is of rounded pebbles, and seems the bed of a river which had deserted its channel. Often we pass small streams of water; and the water is continually dripping from the ends of the stalactites, the echoing sound of which, when it drops, forms the only interruption to the profound silence which reigns throughout the cavern.

To give an idea of the diversified shapes which these concretions assume in the progress of their formation, (and they are constantly forming,) would be impossible. Suffice it to say, that there is scarcely any thing on earth to which they may not be supposed to form a resemblance; and yet, in fact, they are unlike any thing but themselves.

It is generally known that the earth in these caves contains the nitrates of lime, and potash, and other salts. The numerous caves which have been found in the Cumberland mountains and other parts of Tennessee, have been very productive of the nitrate of potash. In the investigation of the causes which have given origin to these salts, it may be recollected, that wild animals burrow in these caves; that when pursued by the hunter, they make them the places of their retreat, and [66] probably die there; that the aborigines have made them a place of burial; and that the streams of water which flow through them in wet weather, carry with them not only great quantities of leaves but many other vegetable productions.

The *natural bridge* is celebrated as one of the greatest curiosities of the world. Viewed by a geologist, it would probably be considered as a cave (so to speak) *unroofed* in all but one place. It seems improbable that if the ravine had been made by a convulsion, which had split and separated the rock to the distance of fifty or sixty feet, any part of it, and particularly so large a mass as that which forms the bridge, should have been left, without exhibiting any marks of violence. The rock is limestone. It is known that this rock wears away rapidly under the attrition of water; and the supposition does not appear improbable, that, in the lapse of ages, so large a creek as that which flows below the bridge, may have worn as deep a ravine as that which now strikes us with so much surprise, In short, may not a cave have been originally formed where the ravine is now, and the pending portion of it have fallen in at every place except that which now forms this celebrated natural curiosity?

Mineral Springs.—The mineral springs of this region are numerous and diversified. Chalybeate springs are promiscuously scattered over the whole of it; and springs impregnated with sulphuretted hydrogen are quite common. Salt springs and licks are found more in the western than the eastern range of mountains. That which was first wrought by William King, is well known. The salt here is associated with gypsum. In the same range of mountains, farther to the southwest, there are now several other salt-works, and also one to the west, on Goose Creek, in Kentucky, which has been very productive.

The Warm Springs.—These springs are situated in a country which presents many attractions to the travelling geologist; and much light, it is hoped, will yet be thrown on the geology of our country, by a more minute and accurate examination of it than has yet been made.

The warm springs ooze through the sand on the south bank of the French Broad river, in the mountains which divide the state of Tennessee from her parent state, about the 36th parallel of [67] latitude. The temperature of the water is about 95° of Fahrenheit.

On the opposite side of the river from the springs is a geological curiosity. A limestone rock is seen dipping under the sandstone which forms the country. Limestone is nowhere else to be seen within six miles of this place. In this limestone rock is a cave similar to others already described.

Paint Rock, in the vicinity of the Warm Springs, is interesting on many accounts. It is a bold precipice on the bank of French Broad river. At this place the river passes with a very rapid current directly across the course of a mountain, which terminates abruptly, and forms the precipice on the north bank of the river. On looking at the rock, the opposite end of the mountain, and the ruins around it, the mind is insensibly carried back to the contemplation of some dreadful commotion in nature, which probably shook these mountains to their bases.

The rock is composed of a *clay slate*; and it is here again remarkable, that this stone is not to be seen in any other place within some miles. It has received its name from some red paintings, (probably left on it by the Indians,) which have the appearance of hieroglyphics.

To conclude. It will be seen from the above observations, that this country presents a vast field of most interesting research, and claims the attention of every traveller who is interested at all in geological inquiries. If what has been said will at all contribute to the enlargement of the general stock of our knowledge on these subjects, the writer will be much gratified; and it is his sincere wish, that the accuracy of his remarks may be tried, and his mistakes corrected, by the researches of succeeding travellers.

ART. XI. *Notice of Professor Mitchill's Edition of Cuvier's Essay on the Theory of the Earth.* [68]

The American scientific public are under obligations to Professor Mitchill for bringing this book within their reach. It is one of the most eloquent, impressive, and instructive works on this grand but obscure subject, with which the world has ever been favoured. The reader is no sooner drawn within the current of Cuvier's eloquence, than he is borne along almost without the power or wish to escape. It is believed there are few intelligent and enlightened persons, whether geologists or not, who would fail to be gratified by a book which secures the understanding by a strict course of reasoning from facts, and delights the taste by a style bold, terse, and lucid, but at the same time rich and flowing.

The analysis of this work has been ably performed in Europe, and there is, therefore, the less necessity to attempt it here. While we take the liberty thus to recommend it, we do not hold ourselves strictly bound to the admission of *every one* of Cuvier's doctrines; and might, perhaps, wish that in a few instances he had been somewhat more explicit, or somewhat more qualified.

The additions by Professor Jameson, of Edinburgh, are valuable and interesting, and are retained in the present edition.

Those by Professor Mitchill will be perused with pleasure and advantage. The learned author has assembled, in one view, a great mass of facts, partly resulting from his own journeys and observations, and partly deduced from other respectable sources. We have no doubt that most of these facts will be considered by the scientific world as very interesting, whatever views they may entertain of the conclusions built upon them. The author has occupied himself principally upon those portions of the United States, which, by the organized remains both of animals and vegetables, with which they more or less abound, exhibit the most decisive and interesting [69] evidence of changes and catastrophes, whose history is to be sought in the memorials entombed in the strata themselves.

We give no opinion regarding the theories of Professor Mitchill, not intending to review the work, but merely to aid, as far as in our power, in drawing the public attention to the interesting subjects about which it is occupied.

If we have any remark to add, it is, that an adherence to the technical precision with which most rocks are at the present day described, appears desirable in mineralogical and geological descriptions. When in the valuable additions before us we read of schorl rock, we gain only the idea of a rock containing that mineral; but as it occurs occasionally in several of the primitive rocks, we are at a loss which is intended; we believe it never forms a rock by itself. So with the slate rocks: there are several varieties of them—mica slate, clay slate, greenstone slate, &c. besides some subdivisions; and the mere word slate does not always give us the precise idea. But we are aware that, in the present case, it was less in view to go into all the details of geological description, than to give a view of our organized remains and of their supposed origin.

ART. XII. *Notice of Eaton's Index to the Geology of the Northern States, together with a Transverse Section of the Catskill Mountain to the Atlantic.*

The extensive collection of facts in this little book of fifty-four pages, is creditable to the author's industry and discernment: he informs us that he has travelled 1000 miles on foot, while investigating the geology of the district concerning which he has written. This district is certainly interesting, and every attempt to diffuse correct information concerning it, deserves encouragement. Mr. Eaton's account of the regions he has explored, has every mark of verisimilitude; and we commend his efforts to diffuse geological information, by short courses of lectures, in different towns. In his arrangement of rocks, he has deviated from Werner—has adopted some views of Bakewell, and some of his own. Werner's arrangement of rocks has, [70] undoubtedly, its imperfections and its redundancies; and yet it may be questioned how far his system has been really improved by its different emendators. If Werner, by mentioning argillaceous schistus only in the primitive class of rocks, left us to dispose of it where we might, when we find it at one time, covering or sustaining anthracite, with impressions of ferns, and at another with impressions of fish and vegetables, and in contact with bituminous coal; still those who, with Mr. Eaton, throw argillaceous slate into the transition class, and omit it in the primitive and secondary, embarrass us with an equal difficulty; for we find argillaceous slate in contact, and alternating with, mica slate, and without any impressions of organized bodies, when we must, without a doubt, call it primitive.

This is the fact with the clay slate of the Woodbridge hills, near New-Haven, which is primitive; that of Rhode-Island, with anthracite, is transition; and that at Middlefields, west of Middletown, with impressions of fish, is secondary. Slate then appears to belong to all these three great classes of rocks.

As to the *metalliferous* limestone, we do not so much object to the introduction of this term by Bakewell, although it appears to us quite as well to say that certain limestones, those of the transition class for example, are metalliferous. But is Eaton correct in referring such limestone as that of which the New-York City-Hall is built, to a metalliferous class? Is not that limestone decidedly primitive? The fact mentioned of its containing pyrites, hardly proves it to be metalliferous; since most rocks contain more or less of pyrites. Some other remarks of less importance we might add, but we prefer concluding by recommending this tract to the perusal of those who wish for information respecting the geological structure of New-England; and we think that Mr. Eaton is seriously aiding the progress of geology in the interior of New-England.

Art. XIII. *Notice of M. Brongniart on Organized Remains.* [71]

This distinguished mineralogist, so advantageously known by his excellent work on mineralogy—his researches in company with Cuvier, into the subterranean geography of the environs of Paris, and his superintendence of the great porcelain manufactory at Sevres, is attempting to form an extensive collection of organized remains.

Through Professor Cleaveland, we have received from him the following

NOTICE

Concerning the method of collecting, labelling, and transmitting specimens of fossil organized bodies, and of the accompanying rocks, solicited by M. Brongniart.

The study of fossil organized bodies appears to be of the utmost importance in determining the relations of different formations, one of the principal objects of geology.

In order more effectually to appreciate the value of this method of investigation, it is necessary to multiply observations—to endeavour to render them exact and precise—and especially to make them upon a general plan.

M. Brongniart has been long occupied in such researches. The essay published by M. Cuvier and him, upon the geology of the environs of Paris, has afforded an example of their use.

He has laboured since this period to apply this method to other formations, which contain the relics of organized bodies; but he stands in need of much assistance, and he presumes to ask it, not only of naturalists, but even of all persons interested in the sciences. By means of the following instructions, he endeavours to avail himself of the kindness of persons the least conversant in the discrimination of fossils.

1. To collect all the fossil organized bodies which can be obtained; especially *the distinguishable impressions and remains of vegetables* from coal countries, and beds of wood, coal, and others. The *shells*, *crustaceæ*, *madrepores*, *fishes*, &c. It is not necessary that these bodies should be either large or entire, but they must be sufficiently characterized to be capable of being recognized. [72]

It is useless to transmit large unmeaning pieces, which are recommended only by their size—such as large ammonites—large madrepores—large pieces of petrified wood—fragments of the one, or small individuals of the other, are often sufficient. We may avoid also collecting the inner moulds ("des moules interieurs") of shells, because they are almost invariably incapable of being recognized.

2. Petrifactions, isolated and detached from their rock, are the most convenient in the determination of species; but when they cannot be separated from the rock, we need not hesitate to send them engaged; it is sufficient if a portion large enough for discrimination is visible.

Among shells, those are preferable which have the mouth or hinge in view; among madrepores, those on whose surface the figures (les étoiles) are distinguishable; among vegetables, those whose leaves are distinctly expanded, (expalmées.)

3. Upon the objects transmitted it is desirable to have, at least in part, the following notices:

1. The exact place from which the object comes: this is the most important circumstance, and the easiest to obtain.

2. The kind of formation in which it is found, and a specimen of the stratum, or at least of the rock, which contained it. It is desirable that this rock exhibit remains of petrifactions similar to those found in the stratum from which it has been drawn.

3. The nature of the formation of which this stratum or rock composes a part, and specimens of as many of the superior and inferior strata as can be obtained, designating the order of superposition of the strata.

4. It is important to designate, by the same mark, all the petrifactions *unquestionably* found in the same stratum, or at least in the same formation. The specimens ought to be almost square— [73]
about three inches or more on a side, and one and a half thick.

5. It is equally important not to mix petrifactions found in different formations, or in different strata of the same formation; or if they are packed together, to distinguish them by numbers, marks, or labels.

When the preceding notices cannot be obtained, the first will suffice.

In order to collect the petrifactions, and to render them useful, it is not necessary to know them, nor to be perplexed to find them out; nor to be afraid of sending objects already known or of little note. A part of the preceding indications, connected with the most common petrifactions, will always render them useful. The important point then is, not to mix those which are found separate, nor to separate those which are found associated in the same stratum.

This is easily attained, by designating by a common number, letter, or any sign whatever, one particular formation or stratum, and by marking with the same sign all the petrifactions which are evidently found together.

The labels designating the place or the geological situation, may be placed in the papers which envelope the specimens, or a number, referring to an explanatory catalogue, may be attached to each specimen.

As far as possible, it is necessary to stick the labels or numbers to the pieces, by pasting; and the surest way is, to write upon the piece itself, 1st, the place where it is found; 2d, the number by which it is indicated in the historical notes above requested.

If there is not time to make out as many numbers or labels as there are pieces, it will be sufficient to unite in one box or packet all the petrifactions of one particular stratum, and to designate them by a general label.

It is necessary to pack the shells and other fragile pieces in separate boxes, and to wrap each piece in a separate paper.

M. Brongniart cannot allow himself to prefer such requests, except under the express condition, that a memorandum of all the expenses which the transportation and packing of the [74] specimens may create shall accompany the letter of advice.

The objects destined for him may be sent by the common modes of conveyance, with a letter of advice, to the following address:

Mr. A. Brongniart, Member of the Royal Academy of Sciences, Engineer of Mines, etc. Rue Saint-Dominique, Faubourg Saint-Germain, No. 71, Paris.

Art. XIV. *Observations on a species of Limosella, recently discovered in the United States, by Dr. Eli Ives, Professor of Materia Medica and Botany, in the Medical Institution of Yale College.*

This small plant was observed in flower in July, 1816, by Mr. Horatio N. Fenn (now of Rochester, State of New-York) in company with Dr. Leavenworth. The plant and the seeds have been preserved by me, in a flower-pot, from that time to the present. The plant was taken a few rods south of Mr. Whitney's gun manufactory, on the margin of the river, where it was covered by every tide. I have since observed the plant in great abundance on the margin of the Housatonuck, in Derby, and in those small streams in East Haven, Branford, and Guilford, which empty into Long-Island Sound.

A specimen of the limosella (with some specimens of the tillea) was sent to Z. Collins, Esq. of Philadelphia, who wrote me that Mr. Nuttall had found the same plant, a few days previous to the receipt of my letter, and that they had no question on the subject of the generic character, but that it would probably prove to be a new species.

In the transactions of the Medico-Physical Society of New-York, page 440, it is described under the name of limosella subulata. A description of the plant was published about the same time, by Mr. Nuttall, in the Journal of the Academy of Natural Sciences of Philadelphia. (See Vol. I. No. 6. p. 115.)

In the paper written by Mr. Nuttall is the following query: "Does this plant, with a lateral mode [75] of growth and alternate leaves, germinate with two cotyledons?" The following observations were made in answer to this question. In the winter of 1816-17 this plant was kept in a situation exposed to severe frost; yet whenever the weather became warm for two or three days, it became quite green, but for the last winter there was no appearance of life in the plant. In March 1818, the vessel in which the limosella had been preserved for two summers preceding, and in which were a great quantity of seeds, was exposed in a warm situation to the sun. There was no appearance of vegetation until the last of March, when were observed several cylindrical leaves, some of them evidently arose from bulbs which had formed the last summer, on account of the dryness of its situation, which frequently occurs when plants are removed from a moist to a dry situation. In other instances single cylindrical leaves arose from the earth, where no bulbs were to be found; these cylindrical leaves were thought to arise from seeds, which, if it was a fact, would prove that the plant vegetated with but one cotyledon. In a short time the vessel was crowded with the seeds of the limosella raised by the cotyledons. These were carefully observed, and in every instance, when the coat of the seed was cast off, two linear cotyledons were observed, soon a cylindrical leaf arose from the centre of the cotyledons, and when this leaf had grown to the length of half an inch, a leaf of a similar kind arose laterally to a line made by the first leaf and the cotyledons.

From the facts above stated, it is thought to be proved that the limosella vegetates with two cotyledons. This was the fact in every instance where the husk of the seeds was obviously attached to the cotyledons, and in the few instances where the plants appeared to vegetate with but one cotyledon, it is probable that it arose from a bulb or some portion of the old plant, in which life had not been extinguished, during the past winter, which was made more probable by the fact that several of the leaves arose obviously from bulbs. This limosella,[11] with its [76] congeners, hence will take its place in the natural order of Jussieu lysimachiæ.

Art. XV. *Professor* Bigelow *on the comparative Forwardness of the Spring in different Parts of the United States, in 1817.*

We have been favoured with an ingenious memoir on this subject, by the author, Professor Bigelow of Boston; it is a part of the fourth volume of the Memoirs of the American Academy of Arts and Sciences.

Professor Bigelow, availing himself of a hint given him some years ago by the late venerable Dr. Muhlenberg of Pennsylvania, ascertained, through the medium of correspondence with accurate observers in different parts of North America, the time of flowering, for "1817, of the common fruit-trees and a few other plants"—"found in most parts of the United States."

The peach-tree was the one most uniformly returned, and the following table exhibits the time of its flowering, in places sufficiently numerous and remote, to afford a fair specimen of these observations:

Places.	*Lat.*		*Long.*		*Peach-tree in blossom.*		
Fort Claiborne, Alab. Ter.	31°	50′	87°	50′	March	4	
Charleston, S. C.	32	44	80	39		6	12
Richmond, Va.	37	40	77	50		23	Ap. 6
Lexington, Ky.	38	6	85	8	April	6	15
Baltimore, Md.	39	21	77	48		9	
Philadelphia, P.	39	56	75	8		15	
New-York, N. Y.	40	42	74	9		21	26
Boston, Mass.	42	23	70	52	May	9	
Albany, N. Y.	43	39	73	30		12	
Brunswick, Me.	43	53	69	55		15 [12]	
Montreal, Can.	45	35	73	11		12	

Professor Bigelow infers, "that the difference of season between the northern and southern [77] extremities of the country is not less than two months and a half." "Difference of longitude does not seem very materially to affect the Floral Calendar within the United States." It appears, that in the same year peach-trees were in blossom at Valencia, in Spain, about the 19th of March; the apple-tree near London, May 8th; the cherry-tree and pear-tree at Geneva, in Switzerland, April 3d.

We hope that this research will be prosecuted in the manner it has thus been happily begun. It evidently affords an excellent criterion of the actual temperature, on a scale more extensive than it is practicable to obtain from thermometrical registers.

Floral Calendars kept in various parts of the United States would afford very interesting information, as to the changes of climate in particular places; a common topic of popular remarks but generally with few and inaccurate data.

Art. XVI. *A Journal of the Progress of Vegetation near Philadelphia between the 20th of February and the 20th of May, 1816, with occasional Zoological Remarks.* By C. S. Rafinesque.

The importance of observations on the annual progress of vegetation is obvious, and, as connected with agriculture, gardening, &c., eminently useful. Comparative observations acquire a particular degree of interest, when made by skilful observers, at the same time, but at different places. Dr. Bigelow, of Boston, issued a circular, proposing that such contemporaneous observations should be made in the spring of 1817; and I wish that his request may have been attended to, when the collection of those observations may afford valuable materials for an American Calendar of Flora. The blossoming of plants is easily watched, but their foliation and [78] budding ought not to be neglected. Having been prevented, by various causes, from keeping an exact record of the progress of vegetation near New-York in 1817, I submit an accurate journal which I had kept the year before, at Philadelphia, in which I hope that some interesting facts may be noticed. Dr. Benjamin Barton has published a sketch of a Calendar of Flora for Philadelphia, in his Fragments on the Natural History of Pennsylvania; by comparing it with mine, many material differences may be traced, which evince a gradual change of temperature, although the spring of 1816 was remarkably cold and late. The greater quantity of species observed by me may, besides, render this journal a sort of vernal Flora of the neighbourhood of Philadelphia; and many species found by me are not to be met in the *Flora Philadelphica* of Dr. William Barton.

February 20. The *Hyacinthus orientalis* begins to show its flowers, and on the

24. In full blossom, as well as *Convallaria majalis*, in rooms.

25. The grass begins to look greenish in some parts.

26. Seen the first larva of insect in a pond.

27. The *Motacilla sialis*, or bluebird, is heard for the first time.

28. The first shad (*Clupea sapidissima*) is taken in the Delaware, while on the same day, the first smelt (*Salmo eperlanoides*) was taken in the Raritan, at New-Brunswick.

March 1. The *Tulipa gesneriana*, and *Hesperis matronalis*, are in blossom at the windows: the suckers (*genus Catostomus*) appear in the fish-market.

2. The catkins of the *Alnus serrulatus* begin to swell.

3. Those of *Salix Caprea* begin to appear.

4. The grass looks green by patches in the country.

5. The leaves of *Veronica officinalis*, *Plantago virginiana*, *Saxifraga virginica*, &c. are quite unfolded.

6. The new leaves of *Kalmia latifolia* begin to appear.

7. The spathas of *Spathyema fetida*, or *Fothos fetida*, begin to appear in blossom.

8. The *Alnus serrulatus* is in full blossom. [79]

10. Found several mosses and ferns in blossom; these last were covered with capsules or old fructification: they were *Asplenium ebeneum*, *Aspidium marginale*, *Asp. acrostichoides*, *Polypodium medium*, N. Sp., &c.

11. Seen the first spider, in the country, brown, oblong, walking. A fall of snow at night.

12. Seen in blossom, at the windows, *Narcissus tazzetta*, *N. janguilla*, and several saffrons, genus *Crocus*, &c.

14. The grass looks quite green; the *Draba verna?* is in blossom in the State-House garden, the *Viburnum tinus*, *Primula acaulis*, &c. in the rooms, &c. The following fish are at market: white perch, (*Perca mucronata*, Raf.) yellow perch, (*Polyprion fasciatum*, Raf.) mamoose sturgeon, (*Accipenser marginatur*, Raf.) elk-oldwives, (*Sparus crythrops*, Raf.) &c.

15. The *Populus fastigiata*, Lombardy poplar, begins to show its catkins.

17. The big-eye herring (*Clupea megalops*) begin to be seen at the fish-market.

18. Many plants begin to grow and show their leaves.

19. A fall of snow. The first shad (*Clupea sapidissima*) appear in New-York: they are now common here.

20. *Crocus aureus* in blossom in gardens; likewise *Iris persica*, &c.

21. *Betula lenta* begin to show the catkins.

22. *Galanthus nivalis*, and *Lamium amplexicaule*, are in blossom in gardens at Cambden.

24. *Populus fastigiata*, and *Salix caprea*, are in full bloom.—The gooseberry bushes shoot their leaves.

25. *Populus angulata* in blossom at Cambden.

26. *Salix babylonica* begins to blossom and shoot the leaves. *Viburnum prunifolium* is budding.

27. *Draba verna?* is in seed already in Cambden: the *Rhododendron maximum* begins to shoot in gardens.

28. *Juniperus virginiana* is in bloom. *Saxifraga virginica* begins to show its flowers. *Laurus benzoin*, and *Cornus florida*, are budding.

April 1. In the morning, a large flight of wild geese went over the city northwards, making a great noise. In the afternoon there was a thunder storm from the southwest. [80]

2. The frogs begin to croak. Found in blossom near Cambden, *Arabis rotundifolia*, Raf., *A. lyrata*, *Saxifraga virginica*, *Draba verna? Betula lenta*, &c. *Pinus inops* is budding.

3. Seen the first swallow. Found in blossom on the Schuylkill, *Fumaria cucullaria*, *Anemone thalictroides*, *Saxifraga virginica*, many ferns and mosses.

4. The fresh-water turtle (*Testudo picta*) begins to show itself.

7. Found in blossom to-day, *Hepatica triloba*, *Laurus benzoin*, *Sanguinaria canadensis*, *Spathyema fetida*, *Acer rubrum*, &c. The first bee is seen.

10. In blossom at the woodlands, *Viola blanda*, *Luzula filamentosa*, Raf., *Gnaphalium? plantageneum*, &c.

12. In blossom at Cambden, *Viola lanceolata*, and *Houstonia cerulea*.

14. The apricot-trees begin to blossom in gardens. *Acernegundo* is in bloom at Gray's Ferry.

15. Seen the first butterfly—it was small and gray. Found in blossom, near Cambden, *Phlox subulata*, *Arabis parviflora*, Raf., and *Vaccinium ligustrinum*.

18. Seen in blossom, *Epigea repens*, *Carex acuta*, and *Taraxacum dens-leonis*. In gardens, the peach and cherry trees are in bloom. Observed many insects. The *Camellia*, the *Magnolia chinensis*, &c. are seen in the hot-house of the Woodlands.

20. The first snake is seen, *Coluber trivittata*, Raf. Also a beautiful large butterfly, red and black. The *Salix vitellina*, and *Capsella bursa*. (*Thlaspi bursa-pastoris*,) are in blossom.

21. Found in blossom, near Gray's Ferry, *Narcissus pseudo-narcissus*, and *Sedum ternatum*,

both naturalized. Likewise the *Populus tremuloides*, and *Mespelus canadensis*. The leaves of *Podophyllum pettatum* are fully expanded.

23. Seen in full bloom in gardens, the pear-tree, plum-tree, *Riber grossularia*, and *R. rubrum*. [81]

24. Found in blossom along the Schuylkill, *Aguilegia canadensis*, *Hyacinthus botryoides*, *Ranunculus fascicularis*, *Violapapilionacea. V. decumbens*, Raf., *Houstonia cerulea*, *Cerastium pumilum*, Raf.

25. Found in blossom near Cambden, *Viola pedata*, *V. lanceolata*, *V. ovata*, Raf., *V. primulifolia*, *Arabis parviflora*, Raf., *Cerastium pumilum*, Raf., *Carex acuta*, *Meopilus botryapium*, *Laurus sassafras*, *Cercis canadensis*, *Potentilla simplex*, *Andromeda racemoca*.

28. Seen in blossom in gardens, *Calycanthus floridus*, *Syringa persica*, *Phlox pilosa*, &c. The leaves of *Liriodendron tulipifera*, *Æsculus hippocastanum*, *Populus fastigiata*, *P. angulata*, are unfolded.

30. In blossom on the Schuylkill, *Obolaria virginiana*, *Anemone trifolia*, *Hydrastis canadensis*, &c.

May 1. In blossom in the Neck, *Cerastium vulgatum*? *Veronica serpyllifolia*, *V. arvensis*, *Ranunculus bulbosus*, *Viola cucultata*.

3. Found above the Falls of the Schuylkill, *Viola striata*, *V. concolor*, *V. primulifolia*, *V. blanda*, *Fumaria aurea*, *F. cucullaria*, *Charophyllum procumbens*, *Uvularia sessitifolia*, *U. perfoliata*, *Cercis canadensis*, *Arabis falcata*, *Stellaria pubera*, *Erigeron pulchellum*, *Orchis spectabilis*, *Hydrastis canadensis*, *Dentaria diphylla*, *Azalea nudiflora*, &c.

4. Found on the Vissahikon, *Arabis bulbosa*, *Panax trifolium*, *Viola pectata*, *V. rotundifolia*, *Cardamine pennsylvanica*, *Krigia virginica*, and several grasses.

7. Found in blossom over the Schuylkill, *Laurus sassafras*, *Viburnum prunifolium*, *Aronia arbutifolia*, *A. melanocarpa*, *Fragaria virginica*, *Cerastium nutans*, Raf., *Convallaria majalis*, naturalized, and several species of the genus *Vaccinium*.

10. Found below the falls of the Schuylkill, *Floerkea uliginosa*, *Viburnum acerifolium*, *Oxalis violacea*, *Cerastium tenuifolium, lechoma hederacea*, &c.: and the following above the Falls [82] —*Trillium cernuum*, *Viola pubescens*, *V. pennsylvanica*, *Hydrophyllum virginicum*, *Polemonium reptans*, *Senecio aureus*, *Saxifraga pennsylvanica*, *Staphylea trifoliata*, *Obolaria virginica*, *Caltha palustris*, *Ranunculus abortivus*, &c.

11. Seen the first bat.

12. Near Haddonfield, *Bartsia coccinea*, *Helonias bullata*, *Trifolium repens*, &c.

15. Found between Cambden and Haddonfield, *Trifolium pratense*, *Silene virginica*, *Antirrhinum canadense*, *Lithospermum tenellum*, Raf., *Festucatenella*, *Seleranthus annuus*, *Oxalis biflora*, Raf., *Poa rubra*, *Vaccinium corymbosum*, *Viola palmata*, *V. parvifolia*, Raf., *Rubus flagellaris*, &c. Also in blossom, *Quercus rubra*, *Q. obtusiloba*, *Q. alba*, &c.

20. Found near Burlington, *Plantago virginica*, *Euphorbia ipecacuanha*, *Comptonia asplenifolia*, *Myosotis lappula*, *Senecio obovatus*, *Scirpus acicularis*, *Lithospermum trinervum*, Raf., *L. tenellum*, Raf., &c.; besides several *Carex*.

Art. XVII. *Description of a New Species of North American Marten*, (*Mustela vulpina*) by C. S. Rafinesque.

The regions watered by the Missouri are inhabited by many animals, as yet unknown to the zoologists, although many have been noticed by travellers. A species of marten has lately been presented to the Lyceum of Natural History in New-York, which was brought from that country, and appears to belong to a peculiar species, very different from the common martens of Europe, Asia, and America, although it has, in common with it, the character of the yellow throat; but the head, feet, and tail, afford so many peculiar characters, that no doubt can be entertained of its diversity. I have, therefore, given to it the name of *Mustela vulpina*, or Fox Marten, owing to its [83] head and tail being somewhat similar to that of a fox.

Mustela Vulpina. Definition—Brown, three large yellowish spots underneath on the throat, breast, and belly; cheeks, inside of the ears, and a spot on the nape, white; tail tipped with white one-third of total length; feet blackish, toes white.

Description.—This animal is of a fine shape: its size is rather above mediocrity, being about half a foot high, and the total length being twenty-seven inches, whereof nine form the tail. The general colour of the fur is of a drab brown, and it is neither coarse nor very fine. The head is elongated, oblong, about four inches long, shaped like that of a fox; the snout is narrow; the nose is black, notched, and granulated, furnished on each side with black whiskers, two inches long: there are three long black hairs, or *vibrissa*, above each eye, and a few shorter ones scattered behind them on the cheeks, chin, and tip of the lower jaw, which is white: the cheeks are whitish, and there is a white spot on the nape of the neck: the ears are large, broad, and white inside. There are three large, oblong spots, on the throat, breast, and belly; this last is the largest; that on the breast the smallest. The fore legs are shorter than the hind ones, and have, behind, three very long hairs or vibrissa: the feet and toes of all the legs are covered with long fur; the former have a dark brown or blackish ring, and the latter are of a dirty white: there are five long toes to all the feet, of which the inner one is the shortest; the nails are white, retractible, and shorter than the fur. The teeth are as in the genus *Mustela*, and white; those of the lower jaw are larger and stronger: the grinders are four on each side; they are broad, trifid, with the middle lobe sharp and very long: the tusks, or dogteeth, are very strong, curved, and approximated, leaving a very small place for the incisores, which are very small, very short, and flat; the two lateral ones on each side are situated diagonally, the second behind, and the two middle ones are only half the size of the others. The tail is bushy, particularly at the top, where there is a white pencil of long hairs; the brown of the remainder is darker than on the body.

From the above accurate description, it will appear evident that this animal is very different from the common marten of North America. It must be a ferocious little animal, and very fierce; which is indicated by the strength of the teeth. [84]

Art. XVIII. *Natural History of the Scytalus Cupreus, or Copper-head Snake.* By C. S. Rafinesque.

After the rattlesnake, the copper-head snake is the most dreaded in the northern states, being the next largest venomous snake: he is also more common in the cold parts, where the former is very rare. Strange as it may seem, this conspicuous and dangerous animal has escaped the notice of naturalists, and is not found described in Shaw nor Lacepede. Having seen two of them near Fishkill, in the summer of 1817, I endeavoured to describe them completely, and investigate their history. They were both killed in a meadow, and one of them while sleeping coiled up near a fence; a slight stroke of a rod was sufficient, as usual with venomous snakes. It appears that they are killed much easier than the innocent snakes; these are often seen to revive after an apparent death, and do not really die until the next sunset; while venomous snakes do not easily revive, particularly if the head is slightly bruised.

This snake is known by a variety of names in different parts of the State of New-York, since he has every where attracted the attention of the inhabitants: these names are, *copper-head*, *copper-snake*, *chunk-head*, *copper-adder*, *copper-viper*, *copper-belly*, *pilot-snake*, *deaf-adder*, *deaf-snake*; and in New-England, by the names *rattlesnake's mate* and *red adder*, &c. They have all been given in reference to his colour, or to some presumed peculiarities in his manners, &c. *Chunk-head* is a vulgar expression, meaning thick-head or blunt-head. He has been called sometimes *pilot-snake*, on a false supposition that he was the pilot or guide of the rattlesnake; and he has been considered as deaf, because he is easily surprised, and does not appear to hear [85] the noise of your approach.

It belongs to the genus *scytalus* of Daudin, &c., which differs from the *Boa* of Linnæus, as the genus *Vipera* does from *Coluber*, being provided with fangs. I have given to it the name of *Scytalus Cupreus*, which means coppered scytalus. The following definition of the species may be considered as comparative and characteristic.

Scytalus Cupreus. Tail one-eighth of total length, with 45 caudal plates entirely brown; 150 abdominal plates, the last very broad; head oval, coppered above, yellow underneath; scales carinated on the back, which is coppered, with reddish brown rings cross-shaped; belly variegated of brownish.

Description. Total length about three feet; body thicker than in the innocent snakes. Head large, broad, oval, obtuse, very distinct from the neck, nearly two inches long, flattened, coppered brown above, and covered with large, smooth scales; yellow underneath, as well as the neck, and with rhomboidal smooth scales. Mouth very large; fangs yellowish white. Back flattened anteriorly, a little angular in the middle, covered with small rhomboidal, obtuse, keeled scales; those of the sides larger and smooth, not keeled; centre of the back of a brownish copper colour; sides of a bright copper; broad bands or rings, becoming forked on each side, and assuming nearly the shape of a St. Andrew's cross; they are of a reddish brown: there is a round spot opposite to the sinusses, and the scales of the sides are minutely dotted of brown. The abdominal plates are 150, beginning under the head; the last, covering the vent, is very broad, double the other: they are of a shining, pale copper colour, with two longitudinal and lateral rows of great, irregular, brown spots, with some light brownish clouds between them, and each plate is marginated of whitish. The belly is very flat and broad, about 1¼ inch in diameter; and the skin may be distended on the sides, when, the animal is not fed. Tail short, tapering gradually, about four inches long, cylindrical, brown, without spots, with 45 plates underneath, and having at the end a small, obtuse, horn claw, of an oblong, compressed, obtuse shape, and carinated [86] underneath.

This snake has many of the habits of the rattlesnake; he is very slow in his motions, rather clumsy, owing to his thick shape and short tail. He retires in winter into caves, hollow rocks, and trees, where he lies, in a torpid state, from November to April; several have been found coiled up together, the head lying over the back: it is in the same situation he sleeps in the fields. When found in the torpid state, they may be carried without waking; but might wake in a warm room. They do not eat during all that time: their food consists of birds, frogs, mice, and even squirrels, which they catch by surprise, as they do not climb on trees. They kill their large prey by breathing a poisonous effluvia, crushing it in their folds, and they swallow it whole after covering it with their clammy saliva. They can remain a very long time without a meal, and one meal is a long time digesting.

They are generally found in meadows, pastures, and the edge of woods. They creep slovenly through the grass, and if surprised by the sight of man, they assume an erect and threatening posture, darting their tongue and swelling their head; but they do not attack men, unless alarmed and struck. They are considered more dangerous than the rattlesnake, because they do not give notice of their vicinity, and lie concealed in the grass; but they are easily killed, when assuming the threatening posture, by a slight touch of a cane, spade, or any other instrument. The effects of their bite is similar to that of the rattlesnake, and cured in the same way, by the prompt application of the *Aristolochia serpentaria*, *Polygala senega*, *Prenanthes serpentaria*, *Macrotry serpentaria*, &c. and other plants, bearing in consequence the name of snakeroots.

This snake is found in New-England, New-York, New-Jersey, Pennsylvania, &c., and perhaps all over the United States.

Art. XIX. *On a Method of Augmenting the Force of Gunpowder.* [87]

Extract of a Letter to the Editor, from Colonel George Gibbs.

I employed, the last year, a man in blowing rocks, and having seen an account of a method of substituting a portion of quick lime for a part of the gunpowder usually employed, I was induced to make a number of experiments upon it. I now send you the results in the certificate of the person employed, whose statement might be relied on, even if I had not superintended myself a number of the experiments.

"*Sunswick Farms, Oct. 19, 1817.*—I certify that, having been employed by Colonel Gibbs in blasting rocks on his farm, I, by his orders, made use of a composition of one part quick lime and two parts gunpowder, and uniformly found the same charge to answer equally well with a like quantity of gunpowder. I made upwards of fifty blasts in this manner, as well as several hundreds in the usual way, and can therefore depend upon the accuracy of this statement. I found, however, that when the powdered lime was mixed with the gunpowder the day before, that the effect was diminished. It should be always used the day it is mixed.

(Signed) T. Pomeroy."

This preparation was made generally in the morning, put in a bottle and well corked, to prevent the access of the external air. The rationale of the process was not explained in the original recommendation, but it soon occurred to me, that it must be owing to the desiccation of the gunpowder by the lime.

The attraction of moisture by gunpowder, is known to be very great: according to Rees's Cyclopedia, upwards of 16 per cent. has been absorbed, and that the removal, simply, from near [88] the fire to the corner of the room, produces a considerable change in its weight. I presume, therefore, that the lime, which in its caustic state has also a great affinity to water, attracts a portion of it from the powder, and leaves it in a state of dryness best fitted for inflammation. But if the lime should remain too long mixed with the powder, it would probably attack the water of crystallization of the saltpetre, and, according to Count Rumford's idea, destroy a great part of the power. If also left exposed, attractions of moisture would take place from the atmosphere, the gunpowder would remain surcharged with humidity as before, and the lime would be only an inert mass.

The examination of this subject led me to consider the increase of the power of gunpowder in various situations, and of its use in the field. It is well known that after a few discharges a cannon becomes heated, and the range is much greater, as well as the recoil. The charge of powder is therefore reduced about one quarter, to produce the original effect. As I have not heard or seen any explanation of this fact I shall take this opportunity of mentioning, that it appears to arise from the same cause as the first explained, viz. the desiccation of the powder. No person will dispute the heat acquired by a cannon, or even a musket, after repeated discharges; and this heat must volatilize or destroy a great portion of the moisture combined with the powder, assist its speedy inflammation, and perhaps add to its power, by causing a more perfect combustion of the inflammable parts of the gunpowder. This would cause a much greater volume of gas to be produced, and the high temperature would also greatly augment its elasticity; and it is well known that the effects of gunpowder depend upon the rapid production and high degree of elasticity of a great quantity of aeriform fluids or gases.

Art. XX. *On The Connexion between Magnetism and Light.* By Col. Gibbs. [89]

Extract from a Letter to the Editor.

I visited, the last year, the mine of magnetic iron at Succassunny, belonging to Governor Dickerson of New-Jersey. The mine had not been worked for a year past, and I did not descend it. The proprietor, a gentleman of distinguished science, informed me of a singular circumstance attending it, which was too important to be left unnoticed. The mine is worked at the depth of

100 feet; direction of the bed, northeast and southwest; inclination nearly perpendicular. The ore in the upper part of the bed is magnetic, and has polarity; but that raised from the bottom has no magnetism at first, but acquires it after it has been some time exposed to the influence of the atmosphere. This fact, of which there is no doubt, struck me as most singular. I could not recollect any similar observation; and it is only lately that I have found that Werner had observed, that iron sand, raised from the depth of 100 feet, had no magnetism. See Rees's Cyclopedia, Art. Sand.

I could only account for this circumstance by supposing that magnetism existed not in the interior of the earth, as was supposed, but only on the surface, and in such bodies as received this principle from atmospheric, or celestial influence.

The late discovery of the magnetic influence of the violet rays of light, by M. Morechini, a notice of which has since reached us in the journals, connected with the above fact, leads me to believe that light is the great source of magnetism. A learned foreigner,[13] whose residence in this country has contributed much to its scientific improvement, has also informed me that other substances than metallic have been found, by compression, to be magnetic.

It is well known that the violet ray is the most refrangible, or has the most attraction to matter. [90] But there are other rays, which Herschel, who some years since discovered them, calls invisible rays, which are still more refrangible, are next beyond the violet, when refracted, and partake of most of its properties, except that they are invisible. I have not yet seen any account of the experiments of M. Morechini, other than the notice in the journal; but I trust I shall soon be able to determine whether those invisible rays do not possess the magnetic power as well as the violet; or, perhaps, possess it exclusively.

As the refraction of the atmosphere in the polar circles, is at least ten times greater than in the tropics, a greater quantity of the magnetic rays will there be separated and combined than elsewhere; and of course arises excess of magnetism. Hence the direction of magnetic bodies towards the northern and southern extreme regions. The great absorption and emission of light in the polar regions, by the ice and snow, may cause the extraordinary illumination of that country during the absence of the sun, and the emission of the magnetic rays with electricity may, perhaps, give us the aurora borealis.

The coincidence of the diurnal variation of the compass with the solar influence, deserves particular notice, and will have considerable weight on this subject.

That there are many facts which cannot readily be explained by the theory of light, I shall not deny; but in the infancy of this system we may be allowed to hope that future observations may enable us to remove present difficulties. One thing must be admitted, that no theory has heretofore been published relating to magnetism, which has received or seems entitled to much confidence. In your next number I hope to be able to furnish you with further remarks on this subject; but, I have no doubt that philosophy will finally determine that we owe to the solar ray light, heat, electricity, and magnetism.

G. GIBBS.

Sunswick, January, 1818.

Art. XXI. *On a new Means of producing Heat and Light, with an Engraving, by J. L. Sullivan, Esq. of Boston.* [91]

Boston, May 7, 1818.

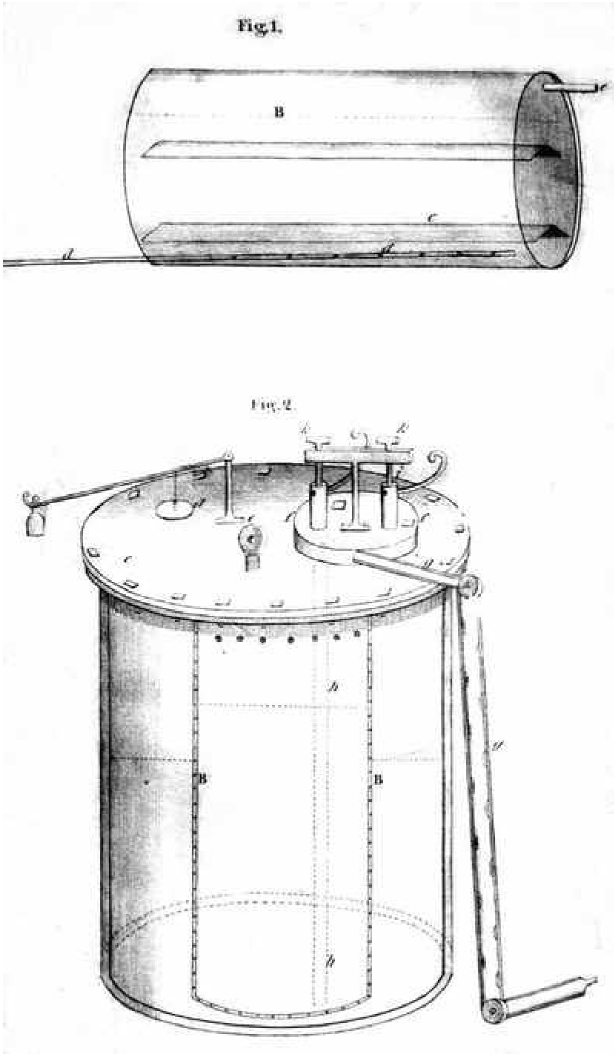
To Professor Silliman.

Sir,

If the following account of a method of using tar and steam as fuel, recently invented by Mr. Samuel Morey, should be found sufficiently interesting to occupy a place in the Journal of Science, I am sensible its usefulness will be much extended through that medium of information.

The inventor, not unskilled in chemistry, and aware of the attraction of oxygen for carbon, conceived it practicable to convert the constituents of water into fuel, by means of this affinity.

Whatever may be the fact, chemically considered, the operation, in various experiments, promises to afford a convenient method of applying to use several of the most combustible substances, not hitherto employed as fuel. By the process I shall briefly describe, *all carbonaceous fluids* may be conveniently burnt, and derive great force from their combination with the oxygen and hydrogen gases of water or steam, before or at the moment of ignition.



NEW FIRE APPARATUS.
Fig. 1. Fig. 2.

A tight vessel, cylindrically shaped, was first employed, containing rosin, connected with a small boiler by a pipe which entered near the bottom, and extended nearly its length, having small apertures, over which were two inverted gutters, inclining or sloping upwards over each other; the upper one longer than the other, intended to detain the steam in the rosin, in its way to the surface. The rosin being heated, *carburetted hydrogen gas* would issue from the outlet, or pipe, inserted near the top of the vessel, and being ignited, afforded a small blaze, about as large as that of a candle; but, when the steam was allowed to flow, this blaze would instantly shoot out many hundred times its former bulk, to the distance of two or three feet.

It is presumed the steam was decomposed, and carburetted hydrogen and carbonic oxide, or [92]
carbonic acid, produced as the steam passed, very near the hot bottom of the vessel.

Another apparatus was constructed, consisting of two vessels, one within the other, having a cover common to both; the inner one to contain *tar*, (as a more convenient substance than rosin;) the outer vessel to contain water, which surrounds the other, and lies under its bottom; or, in other words, a vessel of tar set into a vessel of boiling water. The boiler has a lining of sheet copper, or tin, to promote the ebullition. The tar vessel being riveted to the cover, holes are made through its sides, near to the cover, to allow the steam to pass in, and act on its surface. The cover being secured on, a safety valve is provided for the steam vessel, and two cocks; one over the tar, the other over the water, are fixed contiguously; the first has a tube, or is elongated to reach nearly to the bottom of the tar, which ascends, and is driven out by the pressure of the steam on its surface. Both cocks conduct to a pipe, wherein is placed a large wire, or metallic rod, which about fills the tube, and is perforated obliquely, or zig zag, to increase the length of the passage, and to mingle the tar and steam more intimately. The gases, or vapours, issue from a small orifice at the end of the pipe; and, being ignited by a little fire, into which it is directed, an intense and voluminous blaze is produced, and continues as long as the materials remain unexhausted. A hot brick, instead of the fire, answers the same purpose.

This apparatus contained but about one quart of tar, (which must always be nicely strained,) and it lasted one and a half hour, and the flame was sufficient to fill a common fireplace, if not allowed to escape, by its violence, up the chimney. Its force will be according to the elasticity of the steam. I regret being unable, since, to make more exact and varied experiments, to demonstrate the economy of this fuel. This point, however, and the chemical facts, will be the subject of a future communication. And probably a form of a stove may be devised, wherein it may be used for the purposes of warmth, light, and cooking; and another apparatus to light streets.

But this invention will be of more special use *as fuel for steam engines applied to navigation*—the purpose principally for which I have purchased the patent right. [93]

This may be the subject of another communication.

ART. XXII. *On the Changes which have taken place in the Wells of Water situated in Columbia, South-Carolina, since the Earthquakes of 1811-12.* By EDWARD DARRELL SMITH, M. D., *Professor of Chemical and Experimental Philosophy and Mineralogy in the South-Carolina College*.

To Professor Silliman.

DEAR SIR,

In answer to your inquiry respecting the changes in our wells, since the memorable period of the earthquakes, I would make the following observations:

These tremendous convulsions of nature commenced in December, 1811, and were continued, at intervals, until the latter end of the succeeding month of March, with different degrees of violence, in this and some of the adjacent states. In November, 1812, I visited this town, and then understood that the wells, which are generally very deep, had an abundance of water in them. This continued to be the case for about one year after; and in the College well, in particular, which was a remarkably fine one, there were always about twelve feet of water, notwithstanding its daily consumption by more than two hundred persons. Shortly after this time, many of the wells in the town began to fail in their usual supply of water, although they were frequently cleaned out and occasionally deepened. Their state became worse every year, until, at length, about three years since, some of them proved to be entirely dry, and most of the others had their water turbid, and diminished to the depth of only two or three feet. A little anterior to this period, [94] what were called the dry years had commenced, and there were, comparatively, very scanty falls of rain until the last spring; since when there has been a very large quantity. To elucidate the subject more fully, it may not be amiss to give some topographical account of the town of Columbia. About a mile from the eastern bank of the Cogaree the town begins to be thickly built up, and at this distance the elevation of ground is supposed to be one hundred feet above the level of the river in its ordinary state. The hill is then tolerably level for the space of a mile or more in its western extent, and its soil is principally composed of a loose, porous sand, with which few, if any, stones are intermixed at any depth that has yet been penetrated. In attempting to account for the failure of the well-waters, it was supposed by some that the earthquakes had produced such changes in the loose texture of the soils, that the veins of water which used to supply the wells, had sunk beneath the level of these reservoirs; but on this head it is to be observed, that there was no remarkable failure of water for one or two years after these changes were supposed to have been effected. Others again, connecting the greatest failure of water with the concurring dearth of rain, conceived that the fact might be explained by the droughts occasioning a deficiency in the river-water, and thus cutting off the supply which they supposed had heretofore percolated from the margin of the river into the wells. If their hypothesis was correct, it was believed that the difficulty would be removed, either by deepening the wells, or by subsequent large supplies of rain. Many wells were immediately deepened from two to eight or ten feet, but the remedy proved very inadequate. And since the great falls of rain, within a year past, although there are somewhat larger supplies of water in some wells, yet there is not the half as much as existed before the earthquakes. The College well, although deepened several feet, does not now contain generally more than four or five feet of water. I must not omit to remark, that two wells, situated in a longitudinal line from north to south, with regard to each other, and also in a lower spot of ground, never failed entirely, although they diminished [95] considerably, and now yield more copious supplies than any others.

Whatever may be the cause of this phenomenon, the effects are so inconvenient, and it is so generally believed that they are likely to be permanent, that the inhabitants of the town are beginning to build cisterns, in order to accumulate artificial reservoirs of water.

ART. XXIII. *Respiration of Oxygen Gas.*

It is not extraordinary, when oxygen gas was first discovered, and found to be the principle of life to the whole animal creation, that extravagant expectations should have been formed as to its medicinal application. Disappointment followed of course, and naturally led to a neglect of the subject; and, in fact, for some years, pneumatic medicine has gone into discredit, and public opinion has vibrated to the extreme of incredulity. Partaking in a degree in this feeling, we listened with some reluctance to a very pressing application on this subject during the last summer. A young lady, apparently in the last stages of decline, and supposed to be affected with hydrothorax, was pronounced beyond the reach of ordinary medical aid. As she was in a remote town in Connecticut, where no facilities existed towards the attainment of the object, we felt no confidence that, even if oxygen gas were possessed of any efficacy in such cases, it would *actually* be applied in this case, in such a manner as to do any good. Yielding, however, to the anxious wishes of friends, we furnished drawings for such an apparatus as might be presumed attainable, and also written and minute directions for preparing, trying, and administering the gas. It was obtained from nitrate of potash, (saltpetre,) not because it was the best process, but because the substance could be obtained in the place, and because a common fire would serve for its extrication. The gas obtained had, of course, a variable mixture of nitrogen or azot, and probably on an average, might not be purer than nearly the *reversed* proportions of the [96] atmosphere—that is, 70 to 80 per cent. of oxygen to 20 or 30 nitrogen; and it is worthy of observation, whether this circumstance might not have influenced the result.

Contrary to our expectations, the gas (as we are since informed by good authority) was skilfully prepared and perseveringly used. From the first, the difficulty of breathing and other oppressive affections were relieved: the young lady grew rapidly better, and in a few weeks entirely recovered her health. A respectable physician, conversant with the case, states, in a letter now before us, "that the inhaling of the oxygen gas relieved the difficulty of breathing, increased the operation of diuretics, *and has effected her cure*. Whether her disease was hydrothorax, or an anasarcous affection of the lungs, is a matter I believe not settled."

Should the revival of the experiments on the respiration of oxygen gas appear to be desired, it would not be difficult to simplify the apparatus and operations so as to bring them within the reach of an intelligent person, even although ignorant of chemistry: and this task, should there be occasion, we would cheerfully undertake to perform.

This interesting class of experiments ought to be resumed, not with the spirit of quackery, or of extravagant expectation, but with the sobriety of philosophical research; and it is more than probable that the nitrous oxyde which is now little more than a subject of merriment and wonder, if properly diluted and discreetly applied, would be productive of valuable effects.

Art. XXIV. *On the Compound Blowpipe. Extract from the Journal de Physique, of Paris, for January 1818.*[14] [97]

CONCERNING HEAT.

"Heat, considered as one of the most important agents, especially in relation to chemistry, and even to mineralogy, has also been the subject of numerous labours, both with regard to the means of augmenting and of diminishing its effects.

"To the former belong the numerous experiments made, especially in England, with the blowpipe, supplied by a mixture of oxygen and hydrogen gases. Mr. Clarke has evidently been more extensively engaged in these researches than any other person, as our readers have perceived in the extracts which we have given from the labours of this learned chemist; but it is proper also to give publicity to the protest (réclamation) made to us in favour of Mr. Silliman.

"We have already stated that Mr. Hare, of Philadelphia, first conceived the idea of forming a blowpipe with explosive gas; but as we have not been conversant with the memoirs of the Society of Arts and Sciences of Connecticut, we have not made mention of Mr. Silliman.

"The fact is, that this chemist, Professor at New-Haven, published, on the 7th of May,[15] 1812, a memoir containing the results of experiments made upon a very great number of bodies, until that time reputed to be infusible; and, among others, upon the alkaline earths, the decomposition of which he effected.

"The experiments of Mr. Clarke were therefore subsequent; but, having been made upon a still more extensive list of substances, they are scarcely less interesting.

"It results then, from the experiments of Messrs. Hare, Silliman, Clarke, Murray, and Ridolfi, that there is really no substance which is infusible in the degree of heat produced by this kind of blowpipe.

"In this new department of physics, it is attempted not only to apply the blowpipe to a very great number of bodies, but so to modify the instrument or apparatus as to give it the highest [98] degree of convenience, and especially to obviate the danger of explosion."

pp. 38 & 39.

REMARKS.

As the results produced by Mr. Hare's Compound Blowpipe, fed by oxygen and hydrogen gases, continue to be mentioned in Europe, in many of the Journals, without any reference to the results long since obtained in this country, we republish the following statement of facts, which was, in substance, first published in New-York, more than a year since. It should be observed, that Mr. Tilloch has since published, in the Philosophical Magazine in London, the memoir which contained the American results, and there have been some other allusions to it in different European Journals, and to Mr. Hare's previous experiments; but still this interesting class of results continue to be attributed to others than their original discoverers.

Yale College, April 7, 1817.

Various notices, more or less complete, chiefly copied from English newspapers, are now going the round of the public prints in this country, stating that "*a new kind of fire*" has been discovered in England, or, at least, new and heretofore unparalleled means of exciting heat, by which the gems, and all the most refractory substances in nature, are immediately melted, and even in various instances dissipated in vapour, or decomposed into their elements. The first glance at these statements, (which, as regards the effects, I have no doubt are substantially true,) was sufficient to satisfy me, that the basis of these discoveries was laid by an American discovery, made by Mr. Robert Hare of Philadelphia, in 1801. In December of that year, Mr. Hare communicated to the Chemical Society of Philadelphia his discovery of a method of burning oxygen and hydrogen gases in a united stream, so as to produce a very intense heat.

In 1802, he published a detailed memoir on the subject, with an engraving of his apparatus, and he recited the effects of his instrument; some of which, in the degree of heat produced, surpassed any thing before known.

In 1802, and 1803, I was occupied with him, in Philadelphia, in prosecuting similar experiments [99] on a more extended scale; and a communication on the subject was made to the Philosophical Society of Philadelphia. The memoir is printed in their transactions; and Mr. Hare's original memoir was reprinted in the Annals of Chemistry, in Paris, and in the Philosophical Magazine, in London.

Mr. Murray, in his System of Chemistry, has mentioned Mr. Hare's results in the fusion of several of the earths, &c. and has given him credit for his discovery.

In one instance, while in Europe, in 1806, at a public lecture, I saw some of them exhibited by a celebrated Professor, who mentioned Mr. Hare as the reputed author of the invention.

In December, 1811, I instituted an extended course of experiments with Mr. Hare's blowpipe, in which I melted lime and magnesia, and a long list of the most refractory minerals, gems, and others, the greater part of which had never been melted before, and I supposed that I had decomposed lime, barytes, strontites, and magnesia, evolving their metallic basis, which burnt in the air as fast as produced. I communicated a detailed account of my experiments to the Connecticut Academy of Arts and Sciences, who published it in their Transactions for 1812; with their leave it was communicated to Dr Bruce's Mineralogical Journal, and it was printed in the 4th number of that work. Hundreds of my pupils can testify that Mr. Hare's splendid experiments, and many others performed with his blowpipe, fed by oxygen and hydrogen gases, have been for years past annually exhibited, in my public courses of chemistry in Yale College, and that the fusion and volatilization of platina, and the combustion of that metal, and of gold and silver, and of many other metals; that the fusion of the earths, of rock crystal, of gun flint, of the corundum gems, and many other, very refractory substances; and the production of light beyond the brightness of the sun, have been familiar experiments in my laboratory. I have uniformly given Mr. Hare the full credit of the invention, although my researches, with his instrument, had been pushed farther than his own, and a good many new results added. [100]

It is therefore with no small surprise that, in the Annales de Chimie et de Physique, for September, 1816, I found a translation of a very elaborate memoir, from a Scientific Journal, published at the Royal Institution in London, in which a full account is given of a very interesting series of experiments performed by means of Mr. Hare's instrument; or rather one somewhat differently arranged, but depending on the same principle. Mr. Hare's invention is slightly mentioned in a note, but no mention is made of his experiments, or of mine.

On a comparison of the memoir in question with Mr. Hare's and with my own, I find that very many of the results are identical, and all the new ones are derived directly from Mr. Hare's invention, with the following differences.—In Mr. Hare's, the two gases were in distinct reservoirs, to prevent explosion; they were propelled by the pressure of a column of water, and were made to mingle, just before their exit, at a common orifice. In the English apparatus, the gases are both in one reservoir, and they are propelled by their own elasticity, after condensation, by a syringe.

Professor Clarke, of Cambridge University, the celebrated traveller, is the author of the memoir in question; and we must presume that he was ignorant of what had been done by Mr. Hare and myself, or he would candidly have adverted to the facts.

It is proper that the public should know that Mr. Hare was the author of the invention, by means of which, in Europe, they are now performing the most brilliant and beautiful experiments; and that there are very few of these results hitherto obtained there, by the use of it, (and the publication of which has there excited great interest,) which were not, several years ago, anticipated here, either by Mr. Hare or by myself.

As I have cited only printed documents, or the testimony of living witnesses, I trust the public will not consider this communication as indelicate, or arrogant, but simply a matter of justice to [101] the interests of American science, and particularly to Mr. Hare.

BENJAMIN SILLIMAN,

Professor of Chemistry and Mineralogy in Yale College.

Art. XXV. *The Northwest Passage, the North Pole, and the Greenland Ice.*

In looking over the foreign journals, we find no articles of intelligence so interesting as those which respect the three subjects mentioned above. Indeed, as they have found their way into most of our newspapers, it is now generally known in this country, that, in consequence of the reported breaking up of the Greenland ice, an expedition has already left England, in two divisions, the one for the purpose of exploring a northwest passage to Asia, around the North American continent, by the way of Davis's Straits; the other, for effecting the same object *by passing over the north pole*.

If Horace thought that man almost impiously daring who first adventured upon the open sea, what shall we say of the hardihood of the attempt to visit THE POLE?—the pole, which it is impossible to contemplate without awe—which, in all probability, has never been visited by any living being—where the dreary solitude has never been broken by human voice—where the sound of war has never been heard, and darkness and cold exert an almost undisputed dominion! What must be the emotions of that man who first stands upon the point of the earth's axis! Who, no longer partaking of the revolution, in circles of latitude, slowly revolves on the axis of his own body, once in twenty-four hours—to whom the sun does not rise or set, but, moving in a course very oblique to the horizon, makes scarcely a perceptible progress in twenty-four hours, and at the end of three months, when he has attained his noon, is only 23° 28′, on the arc of a vertical circle, above the horizon—to whom longitude is extinct, and who can move in no possible direction but south—to whom the stars are a blank, and to whom the polar star, could he see it, [102] would appear in the zenith. Such are some of the most obvious results of a position on the pole. The man who first establishes himself on this sublime point, will have more reason for self-congratulation than he who led the Persian myriads into Greece, or he who pushed the Macedonians to the Indus.

On these interesting subjects, we beg leave to refer our readers to a very able treatise in the Quarterly Review for February, 1818, where all the topics at the head of this article are discussed with much learning and ability.—We extract the following passage:

"If an open navigation should be discovered across the polar basin, the passage over the pole or close to it, will be one of the most interesting events to science that has ever occurred. It will be the first time that the problem was practically solved with which the learners of geography are sometimes puzzled—that of going the shortest way between two places lying east and west, by taking a direction of north and south. The passage of the pole will require the undivided attention of the navigator. On approaching this point, from which the northern coasts of Europe, Asia, and America, and every part of them, will bear *south* of him, nothing can possibly assist him in determining his course, and keeping on the right meridian of his destined place, but a correct knowledge of the *time*: and yet no means of ascertaining that time will be afforded him. The only *time* he can have, with any degree of certainty, as long as he remains on or near the pole, must be that of Greenwich, and this he can know only from good chronometers; for, from the general hazy state of the atmosphere, and particularly about the horizon, and the sameness in the altitude of the sun at every hour in the four-and-twenty, he must not expect to obtain an approximation even of the apparent time, by observation, and he will have no stars to assist him. All his ideas respecting the heavens and the reckonings of his time will be reversed, and the change not gradual, as in proceeding from the east to the west, or the contrary, but instantaneous. The magnetic needle will point to its unknown magnetic pole, or fly around from [103] the point of the bowl in which it is suspended, and that which indicated north will now be south; the east will become the west, and the hour of noon will be that of midnight.

"These curious circumstances will probably be considered to mark the passage by the pole, as the most interesting of the two, while it will perhaps be found equally easy. We have, indeed, very little doubt, that if the polar basin should prove to be free from land about the pole, it will also be free of ice. A sea of more than two thousand miles in diameter, of unfathomable depth, (which is the case between Greenland and Spitzbergen,) and in constant motion, is not likely to be frozen over at any time. But if all endeavours to discover a passage to the Pacific by either route should prove unavailing, it will still be satisfactory to have removed every doubt on this subject by ascertaining the fact. In making the attempt, many objects interesting and important to science will present themselves to the observation of those who are engaged in the two expeditions. That which proceeds up Davis's Straits, will have an opportunity of adjusting the geography of the northeast coast of America, and the west coast of Greenland; and of ascertaining whether the latter be not an island or an archipelago of islands; and much curious information may be expected from both.

"They will ascertain, what is as yet but very imperfectly known, the depth, the temperature, the saltness, and the specific gravity of the sea-water in those high latitudes—the velocity of the currents, the state of atmospherical electricity in the arctic regions, and its connexion, at which we have glanced, with the inclination, declination, and intensity of force of the magnetic needle; on which subject alone, a collection of facts towards the upper part of Davis's Straits would be worth a voyage of discovery. It has, indeed, been long suspected that one of the magnetic poles will be found in this neighbourhood, as in no part of the world have such extraordinary phenomena been observed, or such irregularities in the vibration and the variation of the needle.

"A comparison of the magnetic influence near the pole, with what it has been observed to be on [104] the equator, might lead to important results; and the swinging of a pendulum as near the pole as can be approached, to compare with the oscillations observed in the Shetland Islands, and in the southern hemisphere, would be a great point gained for science."

We have no room in this Number to consider the probability of success in this attempt, nor the question, whether the breaking up of the Greenland ice, and its passage to, and dissolution in, the south, have been attended with a chilling influence on the continents. That such a chilling effect might be extensively exerted, is certainly credible. Approaching some of the icebergs, in

April 1805, on the shoals of Newfoundland, we were rendered very sensible of the vicinity of such dangerous neighbours, by the great chill in the air, long before they were visible; and when we had passed them, the weather again grew milder.

Perhaps it militates against the probability of finding the northern polar basin free of ice, that Captain Cook, in his approximation to the southern pole, in January, 1773, when in latitude 67° 15′ south, "could proceed no farther; the ice being entirely closed to the south, in the whole extent from east to west-southwest, without the least appearance of any opening." The advanced season of the year did not, however, permit Captain Cook to ascertain whether he could coast around this ice—whether it was ultimately attached to land, or was a part of a vast field extending to the south pole. This last is however highly improbable, because being found about 23° from the pole, it is hardly credible that it would occupy so extensive a region as to embrace the pole, and, perhaps extend as much farther beyond; especially as in similar latitudes in the opposite hemisphere, navigation is comparatively free, and has been pushed even to more than 80° of north latitude.

The scientific, as well as the commercial world, will wait with no small impatience for the termination of the two grand arctic expeditions, which are among the most original and daring, and may be among the most interesting and momentous hitherto undertaken by man.

FOOTNOTES:

[1] I trust the public will pardon me for stating, that various scientific friends, despairing of the revival of the Journal of Dr. Bruce, had, for some time, pressed me to undertake the editing of a Journal of Science. Considerations of personal friendship prevented me from listening to such proposals till the decline of Dr. Bruce's health, attended by the most alarming symptoms, rendered it very obvious that his Journal would not be revived. Towards the close of last November, in a personal interview, I communicated to him the design of the present work, at the same time offering to waive it, provided he considered it as probable that his own Journal would be resumed. Of this, however, he gave no encouragement; but, on the contrary, expressed his warm approbation of my undertaking, authorized me to consider him as a contributor, and to make public use of his name as a patron. It was not till after this that the annunciation of this work took place; and it is certain that had not all hope of the resumption of Dr. Bruce's Journal been completely cut off, *this* would not have appeared.

[2] The efforts of Stephen Elliott, Esq. of South Carolina, in regard to the botany of the Southern States, are particularly worthy of imitation and praise.

[3] From the MS. papers of the Connecticut Academy, now published by permission.

[4] See Kollmann's Harmony, p. 13, &c.

[5] Tilloch's Phil. Mag. Vol. XXVIII. p. 140.

[6] The propriety of making 25 : 36 the true ratio of the 5th will be manifest, when it is considered that this is the value of that interval as sounded by voices and perfect instruments; when the 3ds which compose it are made perfect. This interval, as found in the scale which has the fewest tempered concords possible referred to at the beginning of this essay, ought to be regarded as the true 5th, flattened by a comma, in the same manner as one of its component 3ds will be allowed by all to be flattened.

[7] The propriety of this limitation will be manifest, when we consider that in organ music, the chords are generally played more full, and are more protracted, than in music for other keyed instruments. It is harmony which constitutes its character, in a higher degree than in music for other instruments. Hence the harmony of the organ ought not to be impaired by including in our computations any music not adapted to it. If a similar examination of music for the piano-forte would afford a set of results essentially different from those of this proposition, this is no proof that it ought to have any concern in a system of temperament designed primarily for the organ, but merely that the same temperament cannot be equally adapted to different instruments. If, as is probable, such an examination would give essentially the same results, to introduce them would be superfluous.

[8] The smaller works of Phillips and Aikin were not then published; had they been, they could not have superseded Cleaveland; the same may be said of the respectable work of Professor Kidd, of Oxford University.

[9] A vast region in the interior of New-York and Pennsylvania is now fertilized by inexhaustible beds of sulphat of lime, (plaster of Paris,) which, till a very few years since, were not even known to exist.

Near New-Haven immense beds of green marble were discovered in 1811, during a mineralogical excursion: this beautiful material, closely resembling the *verd antique*, is now, on the spot, wrought into tables, fireplaces, and many other ornamental forms; and although the farmers had made fences of it for 150 years, no one suspected what it was till the study of mineralogy, in Yale College, brought it to light.

[10] See Tilloch's Phil. Mag. Vol. XLII. p. 182.

[11] In the Journal of the Academy of Natural Sciences of Philadelphia this plant is called limosella tenuifolia.

[12] No return of this tree was made from Brunswick. The date of the cherry-tree is therefore substituted, which is usually in blossom at the same time.

[13] Mr. Correa de Serra, Minister of the King of Portugal.

[14] Communicated by a friend at Paris.

[15] See Transactions of the Connecticut Academy, and Bruce's Journal, Vol. I. p. 199.

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[16] *ERRATUM.*
In the text this Article was, by inadvertence, numbered XIX, and all the succeeding Articles of this Number are marked *two* higher than they ought to be.

THE [105]

AMERICAN

JOURNAL OF SCIENCE, &c.

MINERALOGY AND GEOLOGY.

Art. I. *Remarks on the Geology and Mineralogy of a Section of Massachusetts on Connecticut River, with a Part of New-Hampshire and Vermont; by* Edward Hitchcock, A. M. *Principal of Deerfield Academy*.

The geology of this tract, from a few miles south of Northampton in Massachusetts, to the north boundary of Brattleborough in Vermont, and of Chesterfield in New-Hampshire, is shown on the subjoined map. The primitive formation, except the argillite, is coloured vermilion; the secondary, blue; and the alluvial, gamboge yellow, according to Cleaveland. The alluvial part is elevated above the bed of Connecticut river from 10 to 100 feet, and, in most places, reposes on red sandstone. The soil in the northern part is generally argillaceous; but in the southern more siliceous. The secondary formation consists chiefly of detached eminences that rise abruptly from the plain, and are composed of red sandstone and puddingstone alternating, except the elevations A and B, (Holyoke and Tom) and a part of the range CD, passing through Deerfield and Greenfield, which are greenstone. The part coloured rose-red consists of argillite, sometimes [106] alternating with mica slate, siliceous slate, or chlorite slate. It is thus coloured to show the extent of the argillite, and not from a belief that this rock is of the transition class; for in this region the argillite is undoubtedly primitive. Some quarries of this rock have been opened in Massachusetts; and in Vermont are extensively wrought. I have not learnt how far the argillite extends northward in Vermont and New-Hampshire. Its strata are almost perpendicular, inclining a few degrees to the west.

The primitive region on the west side of Connecticut river, included by the map, is made up of mica slate, as a prevailing rock, particularly in the northern part. Hornblende slate sometimes alternates with this, and sienite appears in various places, though its strata are generally thin. Limestone also occurs in Deerfield, Conway, Colrain, &c. of a dull brown colour. It contains so large a proportion of silex that it is often but little removed from granular quartz. Lime for building has sometimes been obtained from it. A range of granite, containing veins of lead ore, appears at Southampton, and proceeds to Hatfield. North of this, the other rocks cover it, and it does not again rise within the limits of the map.

Sienite is the prevailing rock on the east side of Connecticut river in the primitive region, more particularly in the southern part. In some places a narrow stratum of mica slate lies next to the conglomerate of the secondary formation, and a low range of graphic and common granite has been observed in Amherst and Leverett, lying next to the mica slate. Other veins of granite also traverse the sienite; and gneiss occurs in many places. The proportion of hornblende in the sienite is generally small, and mica is often present in considerable proportion. Porphyritic sienite is common in this quarter, and steatite occurs in its eastern part.

Most of the primitive region on the map is broken and mountainous, being made up of parallel ridges and detached eminences. The strata run nearly north and south, and dip to the east at angles between 20° and 60°. It would be easy to extend the map on the west to the top of Hoosack mountain, since the country is all primitive; and on the east the primitive continues, [107] with a few exceptions, to the ocean. The map might also be extended to the boundary of Connecticut, by prolonging the primitive ranges with some divergency, and colouring the intermediate space secondary, except a narrow tract on the east side of Connecticut river, which is alluvial. These extensions were not thought necessary.

In the town of Gill, at E, there is a cataract in Connecticut river, from 30 to 40 feet in height; and it is believed that the alluvial region, and part of the secondary shown on the map from this fall to the place where the river passes between mount Holyoke and Tom, was formerly the bed of a lake: for the logs are still found undecayed in many places, from 10 to 20 feet below the surface; the river has evidently worn a passage between Holyoke and Tom: many of the hills on the northern part, and the sandstone on the plain, bear the marks of having been washed by water, and the channels of two rivers are still visible in Deerfield, the one 30, and the other 100 feet above the present bed of Connecticut river. Between mount Tom and the mountains west, there is a secondary plain of sufficient height to throw back the water over the supposed bed of the lake, before a passage was worn between Holyoke and Tom. South of these hills commences another alluvial and secondary tract, extending on both sides of the river to Haddam, in Connecticut, where the river passes between mountains, and perhaps this region also was the bed of a lake.

The plain on which the village of Deerfield stands, with the adjoining meadows, is sunk 50 or 60 feet below the general alluvial tract, and was undoubtedly the bed of a pond, or small lake, that remained after the larger one of which we have spoken had subsided. When this larger lake decreased, Deerfield river was cut off from a communication with the Connecticut by the mountain CD, and the plain extending westward from this mountain. There is a tradition, derived from the aboriginals of Deerfield, that the passage in which Deerfield river now runs through the mountain CD, was begun by a squaw with a clam-shell.

On the margin of these meadows, at considerable elevation, numerous small conical [108] excavations appear. On digging below the surface, stones are found calcined by fire. These are probably the spots where Indian wigwams formerly stood. Many vestiges of the aboriginals are frequently found in Deerfield, such as beads, stone pots, mortars, pipes, axes, and the barbs of arrows and pikes. Near the village they had a burial-ground, where many skeletons have been uncovered. A roll of human hair was lately found here, by Mr. J. C. Hoyt of Deerfield, three-fourths of an inch in diameter, and three inches long, closely tied by a string made of the hide of some animal, which string was encircled by brass or copper clasps greatly oxidized; but the hair and string were in a good state of preservation, though they must have lain there more than a century. In the meadows, logs, leaves, butternuts, and walnuts are found undecayed, 15 feet below the surface; and stumps of trees have been observed at that depth standing yet firmly where they once grew. In the same meadows, a few years since, several toads were dug up from 15 feet below the surface, and three feet in gravel. They soon recovered from a torpid state, and hopped away.

The small range of hills beginning at the south line of Deerfield, and terminating in Gill, deserves description. At its commencement on the south, a conical hill, called Sugar Loaf, of red conglomerate, rises abruptly from the plain 500 feet. The appearance of this hill, as you come from the south, is picturesque, and it is an interesting feature of the country. The range becomes higher for three miles, where, at its greatest elevation, it is 730 feet above the bed of Deerfield river. The west side of the mountain is precipitous, and in some places naked. The ascent on the other side is gentle.

Both sides of this hill are sandstone and puddingstone, frequently alternating: though these are most extensive on the west side, and as we rise the puddingstone predominates. The strata dip to the east about 10 degrees. Near the centre of this range is a ridge of greenstone, with a mural face on the west, and amorphous masses lying at the base, half way up to its summit. This ridge [109] does not rise so high as the puddingstone on the west of it, as may be seen in the view of strata with the map. It commences on the west bank of Connecticut river, about a mile north of the hill C, and increases in elevation nearly to the spot where it disappears at the fall of the river in Gill. This rock does not appear to rest on sandstone, but to descend through it, where there is an opportunity for observation. Deerfield river has worn a passage through the sandstone and greenstone 150 feet deep, and the greenstone passes under its bed, and the sandstone, at a few rods distant lies on each side of the greenstone. A similar fact has been noticed at the fall in Connecticut river, in Gill. Yet I have coloured this greenstone secondary on the map; for it is certain that Mount Tom rests on sandstone, and it is stated by Professor Silliman, that the same rock does in Connecticut. Could we penetrate deeper below the surface, it is probable the same would be found to be the case with this greenstone.

As stated above, this rock disappears near the cataract in Gill, and it is succeeded by puddingstone. But four miles farther north, it again emerges in Bernardstone, though it rises but little above the surface. Here its character is changed. The hornblende is more crystalline, and the rock becomes decidedly primitive, as you approach a mountain of argillite and mica slate, into which it passes, and no greenstone has been observed north of this. It terminates not far from the line of Vermont. The red sandstone and conglomerate also terminate on the opposite side of the river in Northfield.

The greenstone in the above described range, is of a finer texture than the same rock in Connecticut; and the feldspar, in some specimens, is scarcely discernible with a microscope. Indeed, in many instances, the eye would decide the rock to be basalt. Much of it is fissile, the laminæ varying from half an inch to a foot in thickness. This is most perceptible among the loose masses; but it exists also in that in place. Whether this circumstance be accidental, I will not attempt to decide.

A large proportion of the greenstone of our vicinity constitutes the base of amygdaloid. The imbedded substances are calcareous spar, quartz, chalcedony, analcime, prehnite, &c. as will be [110] more particularly mentioned hereafter. Globular concretions of greenstone are common in this amygdaloid, several inches in diameter, and of greater specific gravity than the other parts of the rock. A great number of columns occur in the same range, having from three to six sides. Some of them are quite regular, and are well articulated, exhibiting at their joints considerable concavities and convexities. They are from one to thirty feet long, and, in their natural position, incline a few degrees to the east, as may be seen in the view of strata with the map; A few have been noticed that make lateral curves. One of these hexagonal columns measures at one end as follows:—Diagonals, 27, 29, and 29½ inches; sides, 16½, 13¼, 11½, 17, 11½, and 16½ inches. The convexity of this column is a little more than an inch. The best instances of these prisms occur one mile east from the village of Deerfield.

Masses of greenstone are found at considerable distance from the range, among the puddingstone. One has been noticed weighing many tons, a hundred rods from the range of greenstone, and on much higher ground. Some of these scattered fragments contain chalcedony. A specimen of petrosiliceous porphyry has been found among the same puddingstone, and also a mass of singular, though not well defined, amygdaloid, whose base is similar to wacke, and imbedded substances are calcareous spar, chlorite, and green earth.

The elevation in the north part of Sunderland, called Toby, from 800 to 900 feet high, is chiefly conglomerate, red, brown, or greenish, which, in some parts, alternates with chlorite slate, secondary argillite, and a sandstone that seems to be passing into gray wacke slate. Some of the imbedded masses in this puddingstone are quite large, its cement is frequently calcareous, its aspect is singular, and it is very different from the puddingstone before described, On the opposite side of the river. At the foot of this mountain, in the bottom of Connecticut river, distinct impressions of fish are found on a schistose rock, like the one above mentioned as passing into gray wacke slate. This same species of slate occurs in several other places at the bottom of Connecticut river, as at the fall in Gill. In this last place bituminous shale has been noticed. [111]

In Mount Toby, in Sunderland, is a cave nearly 150 feet above the bed of Connecticut river. It opens to the north and west, forming a quarter of a circle, is 130 feet in extent, 60 feet deep, and from 3 to 20 wide. A little to the south of it, is a fissure in the puddingstone, formed by a separation of the rock, ten feet wide, and as deep as the cave. So perfect is this division, that it appears as if cloven down by the sword of some Titan. Perhaps this cave and fissure were formed by the washing of the waters of the lake we have mentioned on the sandstone and conglomerate beneath; thus causing the superincumbent rock to fall and separate. There is no appearance of any other convulsion. Imperfect, calcareous stalactites are found in this cave.

The falls in Connecticut river, at E, are not unworthy of notice. The river here is about 40 rods wide, and the height of the main cataract, raised considerably by an artificial dam, is 30 feet. The fall continues two miles. On the north bank you view the cataract from elevated ground, and can see the river nearly a mile above and below—above, perfectly smooth and calm, below, forming a quarter of a circle, and tumbling among the broken rocks. On the opposite side of the river are a few buildings, the commencement of a canal, and, behind these, moderately elevated hills, covered with woods. Two rocky islands near the middle of the descending sheet, and another thirty rods below, add much to the beauty of the view. Looking from the southeast shore, you have a partial prospect of the falls, and a view of an amphitheatre of greenstone hills, through which a small river empties. The pleasure derived from the view proceeds more from its wildness than its sublimity.

The position of the hills, boundaries, and rivers, on the accompanying map, may not, in all cases, be precisely correct. The general outlines were enlarged by a pentegraph from Carleton's map of Massachusetts, and the intermediate objects were placed chiefly by the eye; their relative situations being determined by travelling over the ground, and viewing them from different [112] elevations. The boundaries of the several formations have not been so carefully noticed near the angles of the map as in the central parts. Of their correctness generally, however, I am confident. The latitude and longitude of Deerfield, from which those on the map were marked, were obtained by taking a mean of the observations given by Gen. E. Hoyt, in the Transactions of the American Academy of Arts and Sciences, and of twelve lunar observations since made. The result is, Lat. 42° 32' 32". Long. 72° 39' from Greenwich.

With the map is given a view of the strata of rocks from Hoosack mountain to eleven miles east of Connecticut river, on a line nearly east and west, passing through Deerfield. The horizontal distances are laid down from a scale: the elevations are assumed. The principal rocks only are coloured; for it is very difficult to determine the breadth of many, since they frequently alternate with one another. I have not examined the country on the east side of Connecticut river with sufficient care to be able to extend the section on that side more than a few miles.

It may not be amiss to mention, that Mount Holyoke, so much celebrated for the delightful view from its top, has been found, with a sextant, to be 830 feet above Connecticut river. Its height has been frequently overrated.

The mineralogy of this section of the country has been but imperfectly explored. I shall mention those minerals only of which I have obtained specimens, and whose localities have not been noticed by mineralogists.

Quartz—several varieties.

1. *Rock Crystal*—abundant. Some good specimens are found in Conway, on feldspar, with the usual hexagonal, prismatic crystals, and these crystals cross each other in all directions.
2. *Irised Quartz*—found in Leyden.
3. *Granular Quartz*—in Deerfield.
4. *Radiated Quartz*—in Whately and Shelburne.
5. *Blue Quartz*—in rolled masses on the banks of Deerfield river.
6. *Greasy Quartz*—in same place. [113]
7. *Pseudomorphous Quartz*—in greenstone, Deerfield.
8. *Lamellar Quartz*—in same place. The laminæ sometimes penetrate crystals of common quartz.
9. *Tubular*, or *Pectinated Quartz*—in same place.
10. *Quartz Geodes*—in same place.

Prase—in the north part of Sunderland. (Not good specimens.)

Amethyst—in Greenstone, Deerfield: the colour is not deep, but delicate.

Chalcedony—in same place—considerably abundant, but generally in small masses.

Carnelian—in same place, not plenty. The chalcedony, in some specimens, seems to be passing into cacholong, and the carnelian into sardonyx.

Agate—in same place. It is made up of chalcedony, carnelian, and quartz. They are generally small, but some are elegant.

Jasper, red, and yellow—found in rolled masses on the banks of Deerfield river and in Leyden. Some have been found imperfectly striped. It occurs frequently as it was formed by the aboriginals into barbs for pikes and arrows.

Petrosilex—on the banks of Deerfield river—not good specimens.

Feldspar—the red variety occurs in puddingstone, Deerfield. It is not necessary to mention any other locality of a mineral so common.

Hornblende—very abundant—mostly black in this vicinity.

Mica—this is very abundant on the east side of Connecticut river. Some crystals of it have been found in Amherst.

Talc—in Shutesbury.

Steatite. The localities of this are seen on the section. The aboriginals formed many articles from this mineral, as pots, pipes, &c.

Chlorite—in Shutesbury: also in amygdaloid, Deerfield. In Deerfield academy there are some Indian pipes of this mineral, well wrought.

Green Earth—in small quantities, in amygdaloid, Deerfield.

Schorl—the black variety occurs in Pelham, Shutesbury, and Orange, Mass., and in Brattleborough, Vermont. [114]

Epidote—in Deerfield, Shutesbury, Leyden, and Pelham, and in Athol, Worcester county. The specimens poor.

Tremolite—in the west part of Leyden, near Green river. The rock in this region is chiefly mica slate, and the quantity of tremolite is very great. Tons of it might be easily collected.

Cyanite, or *Sappare*—in Deerfield, in mica slate; discovered by Dr. S. W. Williams.

Actynolite—rare, found in Shutesbury.

Serpentine—found in Leyden in rolled masses. Some of the specimens admit a fine polish, and the ground is handsomely variegated. It has not been noticed *in situ*.

Asbestus—compact, in Pelham.

Garnets—very plenty in Conway, Deerfield, Shelburne, &c. Good specimens of the melanite occur in Conway.

Native Alum—in Leyden, in small quantities, efflorescing on argillaceous slate.

Sulphur—in Conway, Shelburne, and Warwick, efflorescing on mica slate.

Prehnite—in greenstone, Deerfield, encrusting the columns and in radiated masses, but rarely crystallized. The veins of it, when in place, are nearly perpendicular.

Zeolite—in same place, not abundant. Some good specimens of the radiated variety are found.

Chabasie—in same place, considerably abundant. No crystals have yet been found whose sides exceed a quarter of an inch. It occurs in the veins of the greenstone, in geodes, on balls of zeolite, on chalcedony, on lamellar quartz, &c.

Stilbite—in same place, not abundant. It is commonly associated with chabasie, and the crystals, though small, are well defined.

Analcime—in same place, very abundant, and is associated with quartz and amethyst, which are sometimes enclosed by analcime. It generally occurs in cylindrical, reniform, and radiated masses. A few perfect crystals only have been observed.

Laminated Calcareous Spar—in the same place, not uncommon. [115]

Chalcedony, carnelian, agate, amethyst, prehnite, zeolite, chabasie, stilbite, and analcime, have been found nearly in the same place; and it may not be amiss to observe, that this spot is distant from Deerfield Academy about one mile, and bears from the same, by a true meridian, E. 2°, 15′ S.

Iron Sand—found in considerable quantity near the falls in Connecticut river, on the Montague shore.

Sulphate of Iron—in Conway, in small quantities, efflorescing on mica slate.

Sulphuret of Iron—in Halifax, Vermont, in abundance; also in Charlemont, Mass., Deerfield, &c.

Magnetic Oxide of Iron—very common in the region west of Connecticut river. I have observed it in Athol, Worcester county.

Specular Oxide of Iron—some veins of this ore occur in Hawley, Bernardstown, and Warwick, and have been wrought to a small extent.

Micaceous Oxide of Iron—in the iron mine in Hawley.

Green Carbonate of Copper—in greenstone, in Greenfield. This ore constitutes a vein on the bank of Connecticut river, passing into the hill on one side, and under the river on the other. It has never been wrought, nor, indeed, is its locality publicly known.

Copper Pyrites—in the same vein, not abundant, at the surface.

Sulphate of Barytes—in the same place, constituting the immediate walls of the vein. Its breadth on the wall varies from an inch to a foot, and the breadth of the vein is 6 or 8 feet.

Galena—in Whately. This is probably from a continuation of the vein of this ore that appears at Montgomery, Southampton, and Hatfield. A single crystal has been found in the same range, in Greenfield, twelve miles north of Whately; but it was not in place.

Red Oxyde of Titanium—in Leyden, crystallized on quartz and tremolite, chiefly on the latter; [116] colour brownish red—specific gravity 4.232; scratches glass, handsomely geniculated, and sometimes several geniculations in the same specimen; in one as many as six could be perceived.

Eagle Stone, or *Nodular argillaceous Oxide of Iron*—one specimen on the banks of Deerfield river.

Rose-red Quartz—a loose mass in alluvial soil, Deerfield.

Red Oxide of Titanium—in Shelburne.

I would acknowledge my peculiar obligations to Professor Silliman, of New-Haven, and to Dr. David Hunt, of Northampton, Mass. for the very generous assistance they have given me in a commencement of the study of mineralogy, and for their liberal aid in this particular communication. Their kindness, it is believed, will not soon be forgotten. To several others, also, I am indebted for communicating facts of importance.

Deerfield, October, 1817.

Art. II. *On the Prairies and Barrens of the West, by* Caleb Atwater, Esq. *in Letters to the Editor*.

Circleville, Ohio, May 28, 1818.

Dear Sir,

I send you for publication in the Journal of Science, an Essay on the Prairies and Barrens found in this country.

Description of the Prairies.

Prairie is a French word, signifying a meadow, but is here applied only to natural meadows. They are found in all the states and territories west of the Allegany mountains, more or less numerous, of greater or less extent. They are covered with a coarse kind of grass, which, before the country is settled in their vicinity, grows to the height of six or seven feet. After these natural [117] meadows are fed upon by domestic animals, the grass does not grow to a greater height than it does in common pastures. Sometimes this grass is intermixed with weeds and plum-bushes. Some of those prairies are dry, while others are moist. Pickaway Plains, in Pickaway county, in the State of Ohio, lying a small distance south of this place, are nearly seven miles in length, and about three miles in width, on ground considerably elevated above the Scioto river, almost perfectly level, and, in their native state, were covered with a great quantity of grass, some weeds and plum-bushes; and in the most elevated places, there were a few trees. This was one great prairie.

Sandusky Plains, lying on the high ground between the head waters of the Whetstone branch of the Scioto river, and the waters of streams running into Lake Erie, are still more extensive than those of Pickaway, covered with a coarse, tall grass, intermixed with weeds, with here and there a tree, presenting to the eye a landscape of great extent.

The moist prairies generally lie along some stream, or at the head of one, on level land, or on that which gently descends. The moist prairies are too wet for trees to grow on them; and whether moist or dry, the soil, for a greater or less depth, is always alluvial, resting on pebbles and sand, such as are found at the bottom of rivers, ponds, and lakes. In some instances, the writer is credibly informed, that the shells of muscles are found imbedded in the pebbles and sand. That these shells, such as abound in our rivers, ponds, and lakes, should be found in low prairies along the banks of waters which frequently overflow them, excites no wonder, nor even surprise; but that these shells should be found thus imbedded in pebbles and sand underneath several feet of alluvial soil, in situations more than one hundred feet above the waters of any stream now in existence, is calculated to perplex the mind of the superficial observer. These prairies are found in the western half of the State of Ohio, and north of the hills adjacent to the river of that name. They are also found in every state and territory west of the Alleganies, from the great northern lakes on the north, to the Mexican Gulf on the south; from the western foot of [118] the Allegany mountains, to the eastern one of the Rocky mountains, up the Missouri. In summer, the grass which spontaneously covers them, feeds immense herds of cattle; in winter, the hay that is cut on them, with a little Indian corn or maize, feeds and fattens the same herds. Some of these prairies extend as far as the eye can reach; others contain only a few perches of ground.

Description of the Barrens.

But besides these prairies, there are also extensive tracts of country in this part of the Union which deserve and shall receive our notice; they are called "*Barrens*." From their appellation,

"barrens," the person unacquainted with them is not to suppose them thus called from their sterility, because most of them are quite the reverse. These barrens are found in a level country, with here and there a gentle rise, only a few feet higher than the land around it. On these little rises, for they are not hills, trees grow, and grass also; but grass and weeds are the only occupants of the soil where there is no rise of ground. The soil is alluvial to greater or less depth in these barrens, though on some of the highest rises there is little or none; the lower the ground the deeper the alluvion. On these gentle rises, where there is no alluvion, we find stiff, blue clay, and no pebbles. Under the alluvial black soil, in the lower grounds, we find pebbles similar to those in the prairies, owing to similar causes. On the little ridges, wherever the land is not too moist, the oak or the hickory has taken possession, and there grows to a moderate height, in clusters. It would seem, that whenever the land had become sufficiently dry for an acorn or a hickory-nut to sprout, take root, and grow, it did so; and from one or more of these trees, in time, others have grown around them in such clusters as we now behold. Where the land is lower, the soil deeper, more moist and more fertile, the grass was too thick, and the soil too wet, for such kind of trees to grow in as were found in the immediate vicinity. Imagine, then, natural meadows, of various dimensions, and of every figure which the imagination can conceive, with here and [119]
there a gentle rise of ground, decked with a few scattering trees or a thick cluster of them, and bearing a tall, coarse grass, which is thin on the rises, but on the lower grounds thick and luxuriant; imagine, also, a rill of a reddish colour scarcely meandering through ground a little lower than the surrounding plain, and you will have a very correct idea of the appearance of these barrens. They are *generally* (not always) found on what, in our western dialect, is called *second bottom*, and not on a level with any streams of magnitude, but rather at their sources. To mention all the counties of this State where these prairies and barrens are found, would be too tedious, and illy comport with the object which we have in view. We shall therefore content ourselves with describing those found in the north half of Fayette county, and the adjoining county of Madison, which may be said to be almost entirely one great barren of more than forty miles extent from north to south, and generally half as much in breadth from east to west. The great barren in Fayette, Madison, and, we may add, in the counties still north of them, is on land elevated from fifty to one hundred feet above the level of the Scioto river, into which the streams that have their sources in this tract of country generally run. This land lies so level that the waters stand on it too long for grain to thrive equally with grass, unless, indeed, the farmer should dig a long drain, which is easily effected by the plough, with a little assistance from the hoe and the spade. But as nature seems to have intended this tract of country for the raising of cattle instead of grain, the husbandman has listened to the suggestion, and in this great barren are found some thousands of the finest cattle which the State affords. Here the horse, the ox, and the swine feed, thrive, and fatten with little expense to their owner; but sheep do not, and never will, thrive on prairie grass, or wet grounds. Fruit-trees, the peach, the apple, the plum, &c. do very well when planted on the gently rising grounds, where the hickory or the oak had once stood. Fruit-trees, such as have been named, thrive very well also on the dry prairies. On the eastern side of the Allegany mountains there neither is, nor was there ever, any thing like these [120]
prairies and barrens, if we except those found in the western part of New-York, in the Genesee country, and in the vicinity of the lakes in that quarter. These, the writer of this saw nearly thirty years since, and before that country was much settled. Those prairies were similar in appearance to ours in the west, and were, beyond doubt, formed by similar means.

Speculations on the Origin of the Prairies and Barrens.

What were the causes which contribute to form these natural meadows? That water was the principal agent in their formation, we very little doubt; but this is not the common opinion. According to that opinion, our prairies and barrens, and especially the latter, were occasioned entirely by the burning of the woods by the Indians, in order to take the wild game. Let us try this opinion by the indubitable appearances exhibited by these prairies and barrens.

They are invariably found in a level country, or in one which is nearly so; and the soil is generally, if not always, more moist than that which is uneven and hilly. Would not the leaves, where the land is dry, burn over with as great facility, or even with greater facility, than the grass would where the land is wet? Would there not be more wild game where they could find their food in plenty, such as acorns and hickory nuts, on which they feed in winter, than on land where no food, except dry grass and weeds, were to be found? It is well known that these prairies and barrens could not be burnt over when the vegetable productions which cover them were growing. At the only season when it is possible to burn them, that is in winter, to what kind of regions do the wild animals resort? Is it not to the thick woods? Every hunter will answer in the affirmative. For the space of twenty-five years, the writer of this lived in the vicinity of Indians, and from information on which he relies, as well as from his own actual observation, he confidently avers that the Indians neither are, nor ever were, in the habit of firing the woods in [121]
order to take game. Erroneous information first propagated such an opinion, and blind credulity has extended it down to us. Another opinion, equally groundless, prevails to a considerable extent; and that is, that these prairies have all been heretofore cultivated by the aborigines, and that the grass having overspread these plains, prevented the growth of trees on them. The Indians, it is to be presumed, never cultivated any other grain than maize, or Indian corn, and yet we see few or no corn-hills in any part of this country. In the western part of New-York, before it was settled by its present inhabitants, thousands and thousands of acres were to be seen, where the trees were as large as any in the forest, and yet the rows of corn-hills were plainly discernible. I refer in a particular manner to what is now called Cayuga county. There the growth of grass had not prevented the growth of trees, nor did it here. We know that some of these

prairies were cultivated by the Indians, but never to any very considerable extent. This country never was thickly settled by Indians, like the shores of the Atlantic and the banks of the rivers running into it. No, it was the ancestors of the Peruvians and the Mexicans who lived here in great numbers, before they migrated to South America.

The question then recurs, by what powerful means were these prairies and barrens formed?

That water was the principal agent, we infer from the fact, that the soil is always alluvial to greater or less depth; the former we call prairie, the latter barren. But how could the country from the southern shore of Lake Erie to Chillicothe, a distance of more than one hundred and fifty miles from north to south, ever be covered with water long enough to form alluvial soil, in many places from four to six feet in depth? I answer, that the Niagara river, the present outlet of Lake Erie, has worn away several hundred feet, and in that way the lake is lowered in the same proportion. The high land, composed entirely of sand, originally extending from the Ohio northerly upwards of forty miles, to Chillicothe, has been worn through by the Scioto river; and the waters which once for ages covered the whole country north of the hills along the Ohio river [122]
have been drained off, and the dry land appears where once stood the waters of lakes Erie and Michigan, then forming but one great lake. I am fully impressed with the belief, that were the bottom of Niagara river as high as it once was, the upper lakes would now, as formerly, empty themselves into the Ohio by the Scioto and Miami rivers, and into the Mississippi by the Illinois. I might proceed to examine every part of the country where prairies and barrens are found; but they have all been formed by the same agent, and that is water. An objection to this opinion may be raised by some, that these prairies and barrens are frequently found in the counties of Delaware, Champaign, Madison, Fayette, &c. on ground considerably elevated. Are they higher than the hills near Chillicothe? From a careful inspection, but without any instruments, I am convinced that they are none of them as high.

There is no perpendicular fall of water, but merely a gradual descent, from Columbus to the Ohio; nay, there is no fall from the very source of the Scioto to its mouth. Every one acquainted with hydrostatics, knows that water will run briskly where the descent is only a few inches in a mile. The writer believes that the Scioto, from its source to the Ohio river, does not descend more than one hundred feet, and that the present surface of Lake Erie is about on a level with the Ohio in a freshet; that before the channel of Niagara river was deepened, as it evidently has been, by the attrition of that mighty stream; and before the hills adjacent to the Ohio were worn down by the waters of the Scioto, the whole country north of Chillicothe, where these hills commence, to Lake Erie inclusive, was covered with water, except the very highest hills in the counties of Greene, &c. which were then islands. What tends to corroborate this opinion is, that on these high grounds we find limestone and other rocks, and indications of gypsum; but no alluvion, and none of those fragments and ruins which are produced by water acting mechanically upon a country for a long space of time. We might mention other parts of country where prairies and barrens abound, and which have been formed by water. Those along Greene river, in Kentucky, have evidently been covered by the waters of that river. The bed of that stream has been [123]
deepened by the constant flowing of the water along its channel; the water is drained off, and the prairies and barrens now occupy the soil which the water had made and formerly covered. The prairies above the falls of Hockhocking, along that river, have evidently been formed in the same way, and owe their origin and appearances to similar causes. There is near Lancaster, on the last-mentioned river in the State of Ohio, and near the great road, a gentle rise of ground in the prairie, which has every appearance of having been an island, and is so called by the people of the vicinity.

In fine, wherever prairies and barrens are found, there, for a long space of time, water once stood, but was gradually drained off. Else why alluvial soil to such a depth, in low situations, and growing thinner as we ascend on ground more elevated? Else why do we find rocks in more elevated tracts of country, and not in prairies or barrens? Else why do we find no alluvion, no grass, but a thick growth of ancient forest-trees on the higher lands? Else why do we find beneath the alluvion of the prairies, pebbles and shells similar to those at the bottom of lakes and ponds? Else why do the higher grounds to this moment present the appearances of so many islands? And all these indications where no stream now in existence could by possibility have reached them?

That the waters which once covered so great a part of this State (Ohio) were drawn off gradually, we infer from the fact, that there is not a single indication of the effects of an earthquake or volcano, from the foot of the Allegany to the banks of the Mississippi: in this region not a stone nor a layer of earth has been misplaced, nor its position changed.

But an interesting inquiry here presents itself. Were the hills along the Ohio, before they were worn away by the streams which now empty themselves into that river, ever high enough to raise the water to the north of them to such a degree that it would overspread the country where the prairies and barrens are now found? Although the height of these hills has not been ascertained by the proper instruments, yet from appearances, not to be mistaken by any person who [124]
examines them and the country towards Lake Erie, these hills are much higher than any land between them and that lake. And from certain indications, (as already remarked,) had not the bed of the Niagara been deepened by the running of that mighty river, Lake Erie, as formerly, would empty itself into the Ohio by the Scioto and Miami; and the great northern lakes would once more discharge themselves into the Mississippi by the Illinois. Lake Ontario, from some cause, (possibly an earthquake, or the wearing away of its outlet, or both,) is considerably lower than it was formerly: in that way the land along its banks, once covered by its waters, is drained, presenting appearances exactly similar to those seen in many of our prairies.

Miscellaneous Remarks on the Prairies and Barrens relative to their Picturesque Features, and to Agriculture and Health, as affected by the peculiarities of these Tracts.

To the traveller, who for several days traverses these prairies and barrens, their appearance is quite uninviting, and even disagreeable. He may travel from morning until night, and make good speed, but on looking around him, he fancies himself at the very spot whence he started. No pleasant variety of hill and dale, no rapidly running brook delights the eye, and no sound of woodland music strikes the ear; but, in their stead, a dull uniformity of prospect "spread out immense." Excepting here and there a tree, or a slight elevation of ground, it is otherwise a dead level, covered with tall weeds and coarse grass. The sluggish rivulets, of a reddish colour, scarcely move perceptibly, and their appearance is as uninviting to the eye, as their taste is disgusting to the palate. Such are the prairies and barrens of the west; but, in order to make ample amends for any deficiency, nature has made them exuberantly fertile. The farmer who settles upon them, by raising cattle, becomes rich with little labour. He ditches those which are too moist for grain; he ploughs and fences them, and raises from seventy to one hundred bushels of maize or Indian corn to the acre, without ever hoeing it. The United States own thousands and [125] thousands of acres of such land in these western States and territories, which, for prompt payment, may be purchased for one dollar and sixty-two and a half cents an acre. One objection to these lands is, the want of timber for fuel and other purposes; and another is, that they are unhealthy: but in many places there is an abundance of peat in the wet prairies, and cultivation will every year render them more and more healthy. Some of them have been cultivated for fifteen or twenty years past with grain, and are as fertile as they ever were. As M. Volney says, "They are the Flanders of America."

Yours, &c. C. A.

ART. III. *Account of the Coal Mines in the vicinity of Richmond, Virginia, communicated to the editor in a letter from Mr.* JOHN GRAMMER, *Jun.*

PETERSBURGH, *Virg. Jan. 28th, 1818.*

Dear Sir,

In compliance with your request, that I would send you some account of the Virginia coal pits, I paid a visit to them soon after my return, in company with Mr. R. W. Withers, and I will now proceed to give you the account proposed.

The pits, which we made the particular object of our visit, are situated in the county of Chesterfield, about 14 miles distant, in a direction W. S. W. from Richmond, and 3 miles south of James' River. The country rises gradually from Richmond to the pits; and, from its sandy appearance, is evidently an alluvial deposit, although its substratum is the granite mentioned by Mr. M'Clure, as extending through this state from S. S. W. to N. N. E. The coal is found on the western or upper surface of the granite, coincident with it both in direction and inclination; but whether they come immediately in contact or not, has not yet been ascertained. The 'bed' of coal is supposed by the miners to be coextensive with the granite, and I can discover no very good [126] reason for disagreeing with them in this particular; but, on the contrary, many circumstances concur to strengthen the opinion that it is really coextensive with the granite. The coal is now procured from at least 25 different pits, opened at convenient distances through an extent of from 50 to 70 miles. It every where commences at the upper surface or termination of the body of granite. Some suppose that it is imposed on the granite; and others, that a thin stratum of slate is interposed between the coal and granite. It is always found covered by the slate. The granite is inclined to the horizon at an angle of 45°, and the coal has the same inclination. And since the coal, as far as it has been discovered, is found to accompany and correspond with the granite, why may we not suppose that it continues to accompany the granite, where it has not yet been discovered? At Heth's pits, the coal is 50 feet thick, measured on a line perpendicular to the surfaces of the extreme strata. At some of the pits between Heth's and James' River, it is 30 feet thick; and at the river, not more than 25 feet. The thickness of the coal on the north side of James' River, at the pits in Henrico and Hanover counties, is variable, but at no place greater than 25 feet; and to the south of Heth's, in the pits extending to the Appomatox river, it is still less thick. These facts would induce the supposition, that the coal was deposited in a bed, near the centre of which Heth's pits were sunk. But, on the other hand, the coal is distinctly stratified, and the number of strata increases as the coal proceeds from the surface of the earth; of course, therefore, the farther you proceed from the outer extremity of the coal, the thicker the body of it will be found; and from the inclination of the coal, the farther you are from its outer extremity the deeper it must be under the surface of the earth. Heth's pits are 100 feet deeper than any that have yet been sunk; and all the pits, that I have seen, appear to be nearer to the outer extremity of the coal. We may conclude, therefore, that if the others had been sunk as far from the outer extremity, they would have been as deep, and the coal would have been found as thick in them as in Heth's. Heth's pits, now so called, were first opened about 30 years since, and worked to some [127] considerable extent. Experiencing, however, much inconvenience from the near approach of the works to a part of the coal which was on fire; and finding, from their unskilful mode of mining, that the business was not profitable, they abandoned the works, and filled up their shaft. Some few years after, Mr. Heth obtained possession of the land; and, having imported two Scotch miners, commenced working the coal again. He has now three shafts open, in a line with each other, in the direction of the vein. They are sunk near the brink of a steep hill, which rises about

180 feet from the western bank of a small brook. The depth of one of the shafts is 350 feet. The other two are about 300 feet deep, each. A steam-engine, constructed by Bolton & Watt, is erected at the middle and deepest shaft. It is used exclusively for pumping out water; but I will not trouble you with an account of the *modus operandi*, as it would be only a repetition of your own description of the same operation at the Cornwall mines. The coal is raised in a box, called by the miners a *cowe*. These cowes contain about two bushels each, and two of them are alternately rising and descending in each shaft. They are raised by means of ropes, fastened to a simple wheel and crank, which is turned by mules. In sinking their shafts, they cut, in the first place, perpendicularly (i. e. to the surface of the earth) through the coal, to its lower surface; and then turning westwardly, they open a horizontal gallery through the inclination of the vein, to its upper surface; by this means, to use their own terms, "gaining a double cut on it." Their principal gallery passes (in the direction of the vein,) by the mouth of each shaft. Its length is 1350 feet, and it is terminated at each end by a hitch or dyke of hard sandstone. (The passage was stopped with rubbish in such a manner as to prevent me from seeing the stone myself, and the gentleman who escorted me through the mines is my authority for its being sandstone; he might possibly, however, have been mistaken, as it is difficult to ascertain what a stone is, in such a place, until it is broken.) When I was at the pits, they were preparing to blast through this rock. At right angles to the principal gallery, they have opened, at convenient distances apart, shorter galleries, [128] running westwardly, and these are again connected by passages parallel to the first or principal gallery. Pickaxes are the only tools used in working the coal, as it breaks very readily, in the direction of the strata. The roofs of some of the passages are perfectly smooth; and in such, the light of the lamps, reflected from the great variety of colours in the coal, presents a very brilliant sight. The gloomy blackness, however, of most of the galleries, and the strange dress and appearance of the black miners, would furnish sufficient data to the conception of a poet, for a description of Pluto's kingdom. A strong sulphurous acid ran down the walls of many of the galleries; and I observed one of the drains was filled with a yellowish gelatinous substance, which I ascertained, on a subsequent examination, was a yellow, or rather a reddish, oxide of iron, mechanically suspended in water.

I mentioned above that a part of the coal was on fire: I could not ascertain when this fact was first observed to exist; and it is not impossible that the coal may have been burning a century, or more. It is highly probable, however, that a comparatively small quantity of the coal is consumed, as the combustion must be greatly retarded by the absence of a sufficient portion of atmospheric air. A strong sulphurous fume issues from an irregular hole in the side of the hill of about 2 feet diameter. The hole appears to be only 4 or 5 feet deep, and the smoke rises into it from cracks, partly filled with loose clay. The earth is very much cracked around the hole, to the distance of 12 or 15 feet; and these cracks are from 1 to 4 inches wide. The mouth of the hole is encrusted with acicular crystals of pure sulphur. Attempts were formerly made to extinguish the fire, by turning water into this hole; and, after every attempt, there was a temporary disappearance of the smoke for several weeks; but never longer than three months. For several years, however, they have desisted from such vain attempts, and have taken advantage of the facility afforded, by the existence of this fire, for ventilating the mines, in the following manner:—They opened a passage from their present, to the old deserted, works; this they can open or shut, by means of a close [129] door. As the old works are very near the fire, the air in them becomes very much rarified by the heat; and probably a considerable portion of it is consumed (as the principal pabulum for the combustion,) and a partial vacuum is produced. When the air in their present works, therefore, becomes impure, they open the door, and a strong current rushes into the old works; its place is again supplied with fresh air through the shafts. Previous to the adoption of this mode of ventilation, they experienced great inconvenience from carbonic acid gas; and some of the workmen had been killed by an explosion of carburetted hydrogen gas. Since this mode has been adopted, they have experienced no inconvenience at all from noxious gases. On inquiry, I was told that the substances passed through, in getting to the coal, varied in the different pits. As far, however, as I could learn by inquiry, and an examination of the heaps of rubbish, the following substances, in the order in which they stand, have been found in Heth's pits:—mould, clay, gravel, fuller's earth, sandstone, (at first extremely coarse and friable, but becoming more compact and hard, and having an appearance somewhat stratified as they descended,) gray and bluish clay slate, hard bluish sandstone, shale, or, as they term it, shiver, white micaceous sandstone, extremely hard; blue slate and shale intermixed, black slate, and then the coal. The depth of these strata differed so much in different pits, that their individual thickness could not be ascertained. Vegetable impressions are very common in the slate next the coal; and they have found the impression of a fish. Pieces of pure charcoal, in the form of sticks, or logs, are frequently found in or on the coal. In sinking one of the pits they met with a perpendicular column, 8 inches in diameter, extending through the slate into the coal; in all about 50 feet. Its surface was distinctly serrated, and at intervals of about 2 inches it appeared jointed, breaking easily at the joints. For the want of a better name I must call it a "lusus naturæ;" for it is neither clay-slate nor mica-slate, nor shale, nor sandstone; but appears to be composed of them all. Masses of a black oxide of iron are sometimes found in the slate; and from its weight and hardness the miners very properly call it ironstone. Iron pyrites are very abundant in the slate, [130] and the heaps of rubbish are white with the sulphate of alumine; yellow ochre is found among the rubbish, but I could not ascertain its relative position with any precision. The side of the hill at the pits is covered with quartz pebbles; some of which are as transparent and beautiful as I ever saw. The country, for several miles around the pits, (i. e. as far as I have seen,) appears to be entirely destitute of rocks or pebbles, and is covered with a light sandy soil. I am unable to inform you of the number of hands employed at, or of the quantity of coal annually furnished from, these pits, as a part of my notes has, by an accident, been rendered illegible.

Thus, sir, I have endeavoured to comply with my promise of giving you an account of the coal pits.[17] In doing this, I have *only* attempted to state facts as they existed; although I have no doubt that my imperfect acquaintance with geology has occasioned many omissions which might have been interesting. To the same cause must be attributed the use of language not always strictly scientific, and a method less exact than might have been desired. With all its imperfections, however, if you can, from the mass of facts, cull any one which may be useful or interesting, I shall be fully compensated by the pleasure of having furnished it, for any trouble I may have been at in doing so. And, if at any time I should be able to furnish you with any information relative to the mineralogy or geology of this part of the country, I hope you will let me know it.

Art. IV. *Sketch of the Geology and Mineralogy of a part of the State of Indiana, communicated in* [131] *a letter to the Editor, by Mr.* W. B. Stilson.

Louisville, (Ken.) August 11, 1818.

Dear Sir,

I have employed a short period of leisure in passing over a portion of the state of Indiana. Among other objects, I was not wholly inattentive to the mineralogical and geological features of the country. I now, with diffidence, transmit to you the result of my inquiries.

Sketch, &c.

The secondary formation of the state of Indiana is abundantly evident. The surface of the soil is undulating, and marked with few elevations which deserve the name of mountains. The rocks are sandstone, limestone, and clay-slate; all of which are disposed in horizontal strata. The sandstone presents nothing remarkable in its appearance. Its colours are various shades of gray and brown. The principal hills are of this formation. The principal colours of the limestone are blue and gray, and their various mingled and intermediate shades. Its secondary formation is very manifest from its almost earthy appearance. In innumerable instances, the limestone rocks contain immense quantities of imbedded shells, of great similarity in form and appearance, and having considerable resemblance, to the common escallop-shell of the ocean. Owing to the easy decomposition of these rocks, and the horizontal position of their strata, they afford many subterranean passages for water. A considerable stream, called Lost River, runs into a cave in the side of a precipitous hill; and, after a passage of 6 or 7 miles under the earth, again makes its appearance, with a large accession to its waters. The traveller's attention is continually excited by cavities in the earth, where the temporary rivulets, proceeding from rains, make a sudden exit [132] through perpendicular perforations in the upper stratum of the rock. There are many such cavities, which do not receive any water from the surface. Some of them are many yards in diameter, forming a regular circular concave, of considerable depth towards the centre. They are vulgarly known among the inhabitants by the name of "*sink-holes*." The localities of slate are few, and present nothing uncommon.

With regard to the particular minerals. On Sand Creek, 60 miles from White River, is an interesting locality of that variety of silex, commonly called burrstone. It has been examined by several practical millers, who do not hesitate to pronounce the specimens which it affords, equal, if not superior, to the French burrs. The locality is twenty acres in extent, and appears to be inexhaustible. The mineral varies very much in its appearance; it is generally porous, and appears to have been puffed up by the escape of some gas, while it was in a state of fusion. A mass of well-raised bread gives no inadequate idea of its configuration. It produces most vivid sparks with steel. Some labourers are employed in procuring millstones from this place; and, such is the size of the siliceous rocks, that they are under no necessity of constructing them of detached masses. They form, of a single rock, millstones of five and a half feet in diameter, which are not defaced by any irregularity, or even earthy cavity. These millstones may be carried down the White, Wabash, Ohio, and Mississippi rivers, to New-Orleans, with great facility. And if they should prove as excellent as it is expected they will, this discovery will shed new lustre upon the accumulating evidence of the mineralogical resources of this republic.

Many other varieties of silex are common: rock crystal, agate, and chalcedony, are often found in the beds of rivulets. I passed a considerable distance upon the banks of a small stream, called Leather-wood creek: the bottom of the creek was covered, the whole distance, with siliceous masses, shaped like oblate spheroids, and of every size, from that of a large melon downwards. On being broken, they presented beautiful geodes of crystallized quartz, amethyst, &c. The outside was often fine chalcedony, and sometimes the interior was the same substance, in the [133] form of balls; all these were sometimes combined, forming agates of great beauty.

Carbonate of lime, crystallized, is sometimes found; and many of the caves afford fine stalactites.

There is a large cave near Corydon, celebrated for the production of sulphate of magnesia, or Epsom salts. It has been explored for the distance of several miles. When it was first discovered, the bottom, in many places, was covered to the depth of several inches, with pure, brilliant, needle-shaped crystals of sulphate of magnesia. By some mysterious process of nature, or rather of Divine benevolence, the production of this useful salt is continually going on. This cave also produces some other salts in small quantities: nitrate of lime, nitrate of magnesia, sulphate of lime, &c.

Where the basis of the country is limestone, the waters always take up a great quantity of lime, and some of them possess great petrifying powers. I saw many specimens of petrifactions: a tuft of moss, the form perfectly preserved; leaves, bark, and branches of trees; insects, and many others.

Many of the springs are strongly impregnated with sulphur, and some of them are saturated with sulphuretted hydrogen. I found the opinion universally prevalent among the people of this state, that the first appearance of these sulphur springs was immediately subsequent to the earthquakes of 1812. They say, that then new springs, impregnated with sulphur, broke out, and the waters of some old springs, for the first time, gave indications of this mineral. A sensible farmer, who has a large sulphur-fountain, boiling up from the bottom of a river near its bank, assured me, that there was no trace of this spring until after the period to which I have alluded. He could have no interest in deceiving me; and if he did deceive me, his conduct could originate only in that love of the marvellous which is so characteristic of the human mind. He moreover assured me that the "water had been growing weaker, (to use his phrase) ever since its first appearance." I have room only to mention, among the minerals of Indiana, many varieties of clay, ochres, gypsum, alabaster, muriat of soda, (very common,) iron ore, and antimony.

Art. V. *New localities of Agate, Chalcedony, Chabasie, Stilbite, Analcime, Titanium, Prehnite, &c.* [134]

Deerfield, &c. In the account of the Mineralogy and Geology of Deerfield, by Mr. Hitchcock, in the present Number, it will be seen, that these interesting minerals (with the exception of titanium) exist in the secondary greenstone of that place. We have specimens, (through the kindness of Mr. Hitchcock,) and observe that the agates, chalcedony, analcime, and prehnite, are imbedded in the trap; the agates are in some instances very delicate in the disposition of their bands, and need nothing but polishing to make them beautiful; the same is true of the chalcedony. The chabasie and stilbite occupy cavities, and the chabasie is often distinctly crystalized in a rhomboid, so nearly approaching a cube, in the quantity of its angles, that the mistake is easily committed of supposing them to be cubes; the crystals are sometimes transparent, and the largest a quarter of an inch in diameter. Titanium is found in Leyden; it is the red oxide—very well characterized—in reddish brown crystals as large as a common goose quill,[18] and, in some instances, perfectly geniculated. It is rare to see finer specimens.

East-Haven. It will be observed, that the great ranges of secondary greenstone, which cut Connecticut and Massachusetts in two, terminate at New-Haven, on the one hand, and some way above Deerfield on the other. By comparing the account of the termination at New-Haven (Bruce's Journal, v. i. p. 139.) with that now published, of the termination at or near Deerfield, it will be seen that the geology and imbedded minerals are very similar. At East-Haven, (one of the branches of the greenstone of New-Haven, and within from three to four miles of the latter town,) chalcedony is often found, sometimes imbedded in the trap, (but perhaps more frequently loose among the fallen stones,) which, although in small pieces, is as perfect in its characters as the [135]
chalcedony of the Feroe Islands. It is of a delicate gray, translucent, mamillary, botryoidal, stalactitical, or impressed by crystals of quartz, which have usually fallen out; sometimes these crystals incrust the chalcedony.

Agates also are found in considerable numbers, both imbedded and loose. They usually consist of bands of chalcedony and quartz, and sometimes of the latter only, variously striped or spotted, or interlaced with jasper, carnelian, and cacholong.

The form of the imbedded agates at East-Haven is commonly ovoidal, or egg-shaped, and frequently it is conical. Some portions of pure chalcedony occur, which are shaped like a long, slender carrot or parsnip, and the situation of the latter in the ground would exactly represent that of the chalcedony or agate in the rock.

The imbedded masses are frequently altogether quartz, and then they are most commonly geodes or hollow balls lined with crystals, commonly very perfect and brilliant, although rarely large. These crystals are commonly transparent and colourless—but they exhibit also most of the varieties of colour which quartz assumes—the amethyst—the smoky—yellow, &c., and occasionally they are tipped and spotted with red jasper.

The spontaneous decay of these trap rocks causes many specimens to be found among their ruins, and many more are imbedded in the solid rock; but the industry of successive classes from the neighbouring college, issuing from Col. Gibbs's cabinet, has now made specimens more scarce.

Woodbury. Twenty-four miles from New-Haven, N.W.

In a geological sketch of parts of the counties of New-Haven and Litchfield, which may appear in a future Number, it will be seen that prehnite, stilbite, and agate are found at Woodbury, in the little basin of secondary greenstone which exists there; the prehnite is abundant—it is not known whether the agates are so, although it is asserted to be the fact; the stilbite was not observed to be abundant, although it was well characterized.

Art. VI. *Account of the Strata perforated by, and of the Minerals found in, the great adit to the Southampton Lead Mine. Communicated to the Editor by Mr.* Amos Eaton, *Lecturer on Geology, Botany, &c.* [136]

To Professor Silliman.

After a laborious geological excursion along M'Clure's Springfield section, for about one hundred miles, I visited Dr. D. Hunt, at Northampton. He observed that you had expressed an opinion, that an attentive examination of all the strata constituting the walls of the artificial avenue or drift at the Southampton mines, would bring facts to knowledge, which might, in some degree, subserve the cause of geological science. I am now at the mouth of the drift, having just completed the labour which you had marked out.

I employed two miners to commence with me, at the termination of the drift, which is now extended 800 feet into the hill. We broke off large specimens, at very short intervals, throughout the whole extent of the drift. We arrived at its mouth with almost a boat load of specimens. I kept a memorandum of every thing which occurred, while under ground; and I have now arranged the specimens, before the mouth of the drift, in the same order in which they were situated in the earth.

Fatigued as I am, I will make my remarks here, in the field, lest something should hereafter escape me, which is now fresh in my recollection. Beginning with the greatest distance to which the miners have penetrated, I will set down my remarks, in fact, in reversed order.

800 feet. The rock is fine-grained gray granite, traversed by veins, lined with quartz crystals, and mostly filled with calcareous spar, often beautifully crystallized. In the same veins blue and purple fluate of lime and copper pyrites frequently occur.

790 feet. The same fine-grained granite is continued, occasionally traversed by veins lined with crystals of quartz; but containing no other minerals. [137]

774 feet. A narrow vein of sulphuret of lead, with walls lined with crystals of quartz. The fairest cubic crystals are slightly attached to the points of the quartz crystals. Yellowish crystals of carbonate of lime are often interspersed among the lead. Sulphate of barytes occurs here also; sometimes in plates meeting at various angles, and forming chambers lined with minute crystals of quartz. Minute crystals of copper pyrites and a little fluate of lime have been found here; also fine specimens of bitter spar. The walls are very compact, fine-grained granite.

760 feet. Coarse, parti-coloured granite. The felspar is flesh-coloured and white; the quartz often bluish or greenish; the mica silvery, greenish, or purplish.

725 feet. A stratum of gray-wacke slate. Texture less firm than of the same rock at the west of Pittsfield. This stratum is very distinct, and about two feet thick.

723 feet. A stratum of serpentine rock, containing very red quartz imbedded in various directions. It is very compact, and mostly green. Here it is but about three feet thick. About ten miles south of this place, on Maclure's Springfield section, near the line between Westfield and Russel, and four miles west from Westfield Academy, I found this same stratum of very great breadth. I say the same stratum, because it is situated in the granitic hill, east of the highest ridge of granite, which is evidently a continuation of this range. Perhaps I may, hereafter, give you an account of my excursion along that section of Maclure, in which I may give you a more particular description of the Westfield serpentine.

720 feet. Coarse granite, with white and flesh-coloured felspar, black and silvery mica.

700 feet. A stratum of red mica slate, about four feet thick.

694 feet. Coarse, flesh-coloured granite. This is the handsomest granite in the whole drift. Here we find the most beautiful specimens of graphic granite, both flesh-coloured and gray. [138]

680 feet. A stratum of Kirwan's stell-stein. That is, an aggregate of fine-grained quartz and mica, without any felspar. The quartz is mostly greenish, probably coloured by the next stratum.

670 feet. Beautiful green soapstone. Very compact, but rather softer than that kind in common use for inkstands.

666 feet. A green, granular aggregate. It seems to be made up of fine fragments of quartz, soapstone, and mica, rarely a little felspar, slightly compacted together.

Remark. All the strata, from the inner termination of the drift to this place, a distance of one hundred and thirty-four feet, are nearly vertical, or a very little inclined. Here they begin to approach a horizontal position.

The green aggregate continues as far as the air-well, a distance of 66 feet, with some trifling variations in the size and proportions of the aggregated fragments.

500 feet. A granulated, schistose aggregate, chiefly of quartz and mica. Though the constituents and the form of the rock correspond very nearly with mica slate, it cannot be considered as the primitive mica slate rock. It is so slightly compacted that it can scarcely be kept from falling to pieces. Its position is nearly horizontal.

480 feet. A stratum of coal, half an inch thick. This stratum may be traced, at different intervals, one hundred and eighty feet along the drift towards its mouth. It lies between the

strata of the last described schistose aggregate.

400 feet. An aggregate appears, alternating with the loose schistose rock, which resembles the red sandstone, but is of a less firm texture.

From this place all the strata, east of the soapstone, occasionally appear, for the distance of about three hundred feet. This is probably on account of their undulatory forms and horizontal position. Most of the way we find the lower part of the walls to consist of a kind of semi-indurated puddingstone. Sometimes a thin stratum of fine, loose sand occurs. At 300 feet the coal stratum disappears, passing below the bottom of the drift. [139]

The last hundred feet is chiefly gravel, which is now supported by timbers.

Southampton, Aug. 26, 1818.

Art. VII. *On the Peat of Dutchess County—read before the Lyceum of Natural History, in New-York, by the Rev.* F. C. Schaeffer, *of New-York, and by him communicated to the Editor.*

In May, 1817, I brought specimens of marl and *peat* from Dutchess county, which were taken from a fen or bog occupying an area of some acres. These fens occur frequently in the towns of Rhinebeck, Northeast, Clinton, &c. in Dutchess county. During a part of the year they are covered with water.

A pit was dug in the bog from which I procured the specimens. The order and depth of the well-defined strata which were exhibited by this excavation, I noted in my memorandum book, from which I extract the following:

After clearing away the fresh sod and recent vegetable mould, there appeared,

1. A stratum or bed of *peat* commonly called *turf*, varying in depth from three to four feet.
2. A stratum of peat and marl commingled; depth two feet.
3. A stratum of pure marl, from two to three feet. Below these there was an appearance of sand and blue clay.

The first, or upper stratum, consists of *compact peat*. This substance, when first taken up, is of a dark brown colour, soft, and rather viscid. Some vegetable fibres and vacuous seeds are distributed throughout the mass. It may be moulded to any convenient form. When perfectly dry, the texture of this variety, of which there is a specimen before you, acquires a high degree of solidity. Its fracture is earthy; the colour is lighter. [140]

I should not have offered more on this subject than the labelled specimen, had I not made a most satisfactory experiment with this kind of fuel, which may be obtained in great abundance in our own State. It is easily kindled; burns with a bright flame; yields a bluish smoke, and produces an odour similar to that which attends the combustion of gramineous substances. But this is momentary. When thoroughly kindled, it burns with less flame, yields a small proportion of blackish smoke, and sulphurous acid gas is evolved, though I cannot discover any pyrites. It burns for a long time, and emits a great body of heat. It leaves a very small proportion of light, grayish white ashes; on which I have as yet made no experiments, having this day, for the first time, paid particular attention to this substance, attracted by the unusual hardness which it acquired since it is in my possession: and not many hours have elapsed since I subjected it to combustion. The attempt succeeded so well, that I cannot refrain from expressing my opinion, that this variety of peat will answer as an excellent substitute for the best Liverpool coal.

Art. VIII. *Notices of Geology in the West-Indies.*

REMARKS.

In the former Number of this work, a notice was published respecting siliceous petrifactions of wood, from Antigua. We now publish a geological sketch of the island, with notices of some other parts of the West Indies. This communication is made by a friend, with permission to publish it. It is a production of the pen of Dr. Nugent, of St. Johns, Antigua, a gentleman of eminent scientific acquirements, who, it is hoped, will continue his laudable and able efforts to illustrate the natural history of the West-Indies.

[141]

Memorandum concerning the Geology of Antigua, &c.

The southern and more mountainous part of the island consists of *trap* rocks; more particularly of trap breccia and wacké-porphyry. On these beds rests a series of very peculiar stratified conglomerate rocks. These strata vary exceedingly in colour and thickness, but all dip, at a considerable angle, to the northwest. The more usual character of this rock, is that of a clayey basis, with minute particles of felspar, and small spots of *grünerde*[19] (or chlorite Baldogée.) This latter is frequently diffused over the whole, and gives it a green tinge: the colour has been thought by some to proceed from the impregnation of copper, but I am rather of opinion that is owing to manganese and iron. The conglomerate character of this rock, is derived from its having imbedded in it, or incorporated with it, numerous fragments, of all sizes, of petrified wood, chert, with and without coralline impressions, agate, jasper, amygdaloid, greenstone, hornstone, porphyry, porphyry slate, and other substances.

On this singular class of strata, reposes an extensive calcareous formation, occupying the northern and eastern part of the island, having *subordinate* to it, and at its lowest part, where it is in contact with the conglomerate, large beds and patches of chert, which contains also a vast variety of petrified woods, several of which are of the palm tribe, with silicified shells, chiefly *cerithea*; though at the Church-hill, at St. Johns, formed of this chert, casts of bivalve and ramose madrepores are likewise found. The calcareous beds are principally of a friable marl, with blocks and layers of limestone irregularly included. In this *formation*[20] are many fossil shells, both in the calcareous and siliceous state; and there appear to be some beds, wherein is a mixture of shells of marine, and others of a fresh water, or at least a terrestrial origin. The coralline agates found in nodules and patches therein, and which may readily be distinguished from the coralline [142]
chert of the previous beds, are the most beautiful which have any where been yet noticed; and when well selected and polished, make very pleasing ornaments.

The island, as well as Barbuda, thirty miles to the northward, the Grande Terre part of Guadaloupe, at a similar distance to the southward and eastward, with several others of the West-India Islands, give proof of an extensive formation, more recent than those to which naturalists have heretofore principally confined their' attention; and which is, perhaps, contemporaneous with, if not later than, the Paris Basin, so well described by Cuvier and Brongniart.

April 10th, 1818. N. N.

N. B. A few specimens are sent.

REMARKS.

If the above paper be read attentively, in connexion with that in No. 1. on the petrified wood of Antigua, it will afford some very curious information to the geologist respecting these petrifactions, and must lead to interesting speculations respecting their origin, under circumstances so very peculiar, and to which we do not recollect to have heard of any parallel.

ART. IX. *Discovery of Native Crystallized Carbonate of Magnesia on Staten-Island, with a Notice of the Geology and Mineralogy of that Island, by* JAMES PIERCE, ESQ. *of New-York, in a Letter to the Editor.*

NEW-YORK, October 19, 1818.

DEAR SIR,

I forward you a few mineral specimens characteristic of Staten-Island, including native carbonate of magnesia, in acicular crystals. I discovered this new form and locality of magnesia [143]
in examining the strata exhibited in an excavation now making, under the delusive expectation of finding gold, about three miles from the Quarantine. In descending the shaft, sunk perpendicularly in steatite, magnesite, veins of talc, and green translucent asbestus were observed at depths from six to thirty-five feet. The magnesite was found to embrace veins and cavities containing native carbonate of magnesia, in very white acicular crystals, grouped in minute fibres radiating from the sides, but not always filling the veins and cavities. The crystals were, in some instances, suspended, assuming a stalactical form. This carbonate of magnesia dissolves entirely in diluted sulphuric acid, with considerable effervescence and chemical action, producing a bitter compound, from which salts of easy solution are formed by evaporation. The magnesite in which these crystals are found, appears to be composed of carbonate of magnesia, steatite, and talc, disintegrating readily upon exposure to air and moisture: it effervesces considerably in sulphuric acid, forming a very bitter fluid that soon exhibits crystals, indicating that magnesia enters in large proportion into its constitution. Magnesite may perhaps be found at this place in quantity sufficient for a successful manufacture of Epsom salts. Small regular hexaedral crystals of mica, were noticed in steatite. Chromate of iron was sparingly diffused through the different minerals raised from various depths.

A few remarks and facts respecting the geology and mineralogy of Staten-Island, may, perhaps, give some additional interest to the specimens presented.

Staten-Island (which constitutes Richmond county) is situated about seven miles southwest of the city of New-York, extends from northeast to southwest about fifteen miles, in a straight line, with an average width of six. It exhibits a considerable diversity of surface. The eastern part is composed principally of elevated ground: a mountain chain is observed to take its rise in the vicinity of a narrow sound called the Kills, and sweep, in a semicircular form, near the eastern shore; it then ranges southwest, parallel with, and distant from Amboy Bay, about two miles, terminating near the centre of the island, and forming, with the exception of some passages, a [144]
continued chain, which, on the eastern and southern sides, is very steep, but not precipitous; it gradually declines to the west and north, and, in some places, it presents on its summit table land of considerable extent. A prominent ridge crosses the island, connecting the elevated ground of

the south, with the hills of the northern part. A species of steatite, containing veins of common, indurated, and scaly talc, amianthus, and most of the varieties of asbestus, and some chromate of iron, constitutes the nucleus of the whole mountain range and elevated ground of the eastern division, stamping it as primitive. This steatite approaches, in most places, within a foot and a half of the surface, and appears in small angular loose blocks, wherever the soil has been removed. Its colour is a greenish yellow; it is brittle, very adhesive to the tongue, but little unctuous, and probably contains more alumine and less magnesia than steatites in general. Much of it decomposes when exposed to air and moisture, and forms a good mould, whenever the descent of ground permits an accumulation of earth. It is not improbable, that in most places of the Staten-Island hills, when magnesia constitutes a considerable ingredient of the rock, it will be found saturated with carbonic acid, obviating the objection to common magnesian minerals in agriculture.

The minerals observed on the surface of the northeast part of this chain of hills are, secondary greenstone, asbestoid, sandstone, granite, and gneiss, sparingly scattered in rolled masses. In addition to these rocks, in the middle and western part of the chain, a mineral of uncommon appearance is observed. It is composed principally of quartz, rough, with numerous cells of various forms, in which small siliceous crystals are generally found: the veins or plates of quartz that intersect each other, often embrace talc and oxide of iron, which, decomposing, gives some specimens the appearance of volcanic origin. Associated with this cellular ferruginous quartz, brown hæmatite is often observed; this valuable ore often yields eighty per cent. of iron of best quality; its fibres assume a variety of shapes; they were observed at Staten-Island, straight and curved, radiating from a centre, and exhibiting the stalactical, cylindrical, and botryoidal forms, [145] often displaying a black polished surface and glistening lustre. Ferruginous minerals are abundant on the mountain for several miles. A granular oxide, called by miners shot-ore,[21] from its being principally composed of spherical grains of various sizes, was often noticed, and appears in some places in extensive beds: it is easily fused, and affords a large per centage of good iron for castings. A heavy ore, with a smooth surface and some lustre, bearing a considerable resemblance to native iron, is sometimes seen. Banks of white sand, resembling the siliceous particles of the seashore, are noticed on the mountain tops, containing masses of compact, heavy ferruginous sandstone, similar to the rocks of our alluvial seaboard. Large beds of water-worn siliceous pebbles, in no way differing from those washed by the ocean, are seen on the height of the ridge, in which excavations have been made several feet, leaving the depth of the mass uncertain. On some of the eminences, for a considerable extent, vegetation is entirely excluded by an iron-bound soil. Iron ore, imbedded in an earth coloured by, and partly composed of, oxide of iron, occupies the surface; and chalcedony and radiated quartz are sometimes observed on the primitive ridge. Prospects from many of these eminences are extensive and diversified. On one side, the ocean and a great extent of coast are in view; on the other, a rich landscape of hills and plains, the eye resting on the highland-chain and the mountains bordering Pennsylvania; the harbour, at your feet, presents a busy, ever-varying scene, and the city of New-York appears to great advantage from this point of observation.

The district between the mountain and the narrows, the thickly settled and well-cultivated plain bordering Amboy bay, and much of the western division of the island, are decidedly alluvial. Adjacent to Fort Tompkins, detached pieces of copper ore have been found. I have observed petrifactions of marine shells in rocks excavated in that neighbourhood, twenty feet from the surface, and sixty above the ocean.

The western part of the island presents moderate elevations; the soil, a good medium of sand [146] and clay, is in general fertile; but a tract near the termination is sandy and barren. Some creeks penetrate to near the centre of the island, and are bordered by extensive salt meadows. Except at the primitive range, I have observed in no part of the island large beds of rock that can be called in place; but rolled masses of greenstone, sandstone, gneiss, granite, red jasper, and indurated clay, appear in general sparingly, but sometimes in abundance, on the surface. Lignite has been found in small quantities in the western part of the island. A chalybeate spring, of no great strength, is the only mineral water met with in Richmond county. The ponds, wells, and streams, contain a soft water, holding no lime in solution.

REMARKS.

We have already published (p. 54.) Mr. Pierce's discovery of the pulverulent carbonate of magnesia, and have pointed out its connexion with Dr. Bruce's previous discovery of the hydrate of magnesia, or pure magnesia combined with water only. Mr. Pierce has now added another important link to this chain, and future mineralogists may quote the vicinity of New-York as affording,

1. Pure magnesia, crystallized and combined with water only.

2. Carbonate of magnesia, pulverulent and white.

3. Carbonate of magnesia, in very delicate and perfectly white acicular crystals.

We possess specimens of them all.

Art. X. *On a curious substance which accompanies the native Nitre of Kentucky and of Africa. Communicated in a letter to the Editor, from* Samuel Brown, M. D. *late of Kentucky, now of the*

Alabama Territory.

REMARKS.

The scientific public were several years ago laid under obligations to Dr. Brown, for a very interesting and instructive account of the nitre caverns, &c. of Kentucky, published in the [147] Transactions of the Philosophical Society, in Philadelphia, Vol. VI., and in Bruce's Journal, Vol. I. p. 100. The following communication arose from a conversation on that subject between Dr. Brown and the Editor.

New-Haven, July 27, 1818.

Dear Sir,

I have just found the passage I referred to the other day, relative to the existence of native or sandrock nitre in the interior of Southern Africa. It is in Barrow, and not in Vaillant, as I thought when I had the pleasure of conversing with you concerning it. I am much obliged to you for recalling my attention to that curious subject, as it has brought to my recollection a fact, which I believe I omitted to mention in my memoir, (viz.) the existence of a black substance in the clay under the rocks, of a bituminous appearance and smell. This I remember to have seen in a rock-house, near the Kentucky river, where very considerable quantities of sandrock nitre had been obtained. This substance was found in masses of a few ounces weight, and in the crevices of the rocks near the basis of the side walls. The smell was not wholly bituminous, but resembled that of bitumen combined with musk. I am quite unable to account for the formation of the nitre, or the production of this black substance which sometimes accompanies it, both in Africa and America. Had I seen Mr. Barrow's travels, when I noticed the bitumen, I should certainly have paid more attention to it. But perceiving no relation between the rock nitre and the masses of this substance, my examination of it was much too superficial. I do not very well understand what Mr. Barrow means by saying, that many wagon loads of animal matter lay on the *roof* of the caverns in Africa. I saw no such matter on the *roof* of the rock-houses in Kentucky. Certainly the caverns have been the habitations of wild beasts, and great quantities of leaves, &c. have been mixed with the debris of the superincumbent rocks, but it does not seem probable, that much animal matter could be filtrated through a roof of rock, perhaps forty or fifty feet in thickness. The [148] subject, however, is very curious, and deserves much more attention than any of us have bestowed upon it.

Extract from Barrow's Southern Africa, p. 291. New-York edition.

"About 12 miles to the eastward of the wells, (Hepatic wells,) in a kloof of the mountain, we found a considerable quantity of *native nitre*. It was in a cavern similar to those used by the Bosgesmans for their winter habitations, and in which they used to make the drawings above mentioned. The *under surface* of the projecting stratum of calcareous stone, and the sides that supported it, were incrusted with a coating of *clear, white saltpetre*, that came off in flakes, from a quarter of an inch to an inch or more in thickness. The fracture resembled that of refined sugar, it burnt completely away without leaving any residuum; and if dissolved in water, and thus evaporated, crystals of *pure prismatic nitre* were obtained. This salt, in the *same* state, is to be met with *under* the sandstone strata of *many* of the mountains of Africa; but, perhaps, not in sufficient quantities to be employed as an article of export. There was also in the same cave, running down the sides of the rock, a black substance, that was apparently bituminous. The peasants called it the urine of the das. The dung of this gregarious animal was lying upon the roof of the cavern to the amount of many wagon loads. The putrid animal matter, filtrating through the rock, contributed, no doubt, to the formation of the nitre. The Hepatic wells and the native nitre rocks were in the division of Agster Sneuwberg, which joins the Tacka to the southwest."

Should I ever visit Kentucky again, I hope that I shall be able to give a better account of these caverns, which certainly are highly deserving of the attention of naturalists.

In Philadelphia you may have an opportunity of seeing some small specimens of the sandrock, containing nitre, now in the cabinet of the Philosophical Society.

Art. XI. *Descriptions of species of Sponges observed on the shores of Long-Island. By* C. S. Rafinesque, *Esq.*

The sponges are one of the most singular productions of nature; and, even to this time, naturalists are divided in opinion respecting their real rank in the scale of organized beings. Some believe that they are animals, belonging to the class of polyps, next to the genus of *alcyonium*, while many contend that they are not animals, but plants, of the tribe of *fuci*, or marine vegetables. I am inclined to adopt this latter opinion, since in all those which I have seen, in Europe and America, no perceptible motion nor sensibility was to be discerned in any stage of their existence; and those who have acknowledged their animality, bring no stronger proof thereof than an occasional slight shrinking under the hand, and an animal smell, which are common to some marine plants.

Whatever be the truth on the subject, these doubtful opinions prove that they are of the many connecting links between animals and plants. This is not a proper place to decide this controversy; I mean merely to make known new species of this tribe of beings, which I observed last year, on the shores of Long-Island. Such a fragment will be, perhaps, the first attempt of the kind; when more species shall be known, the subject may be investigated with more certainty and accuracy.

1. *Spongia albescens*, Raf. (Whitish sponge.) Effuse, compressed, irregular, perforated, somewhat branched, unequally lobed, whitish, smooth; lobes truncated; cells porose, very minute, nearly equal; small unequal cells inside.

Found near Bath and Gravesend, in sandy bottoms. A large species, sometimes over a foot broad, of quite an irregular shape, rather flattened, about one inch thick; partly gibbose; concave [150] now and then, and with large, irregular openings, as if large branches were anastomosed; circumference branched or lobed, very jagged, sinus obtuse, lobes elongated obtuse, truncate or flat, unequally divided. The substance is entirely of a cinereous white, outside and inside, of a soft and brittle nature, rather friable; covered outside with minute pores of an oblong or round shape, and full of small unequal cells inside.

2. *Spongia ostracina*, Raf. (Oyster sponge.) Very branched, erect, red, papillose; branches unequal, often dichotome, obtuse; cells porose, oblong, nearly equal.

It is often found on the common oyster. (*Ostrea virginica.*) It rises from four to six inches, the colour is a fine red, it branches from the base; the branches are unequal, straight, cylindrical, or compressed. Substance stupose. Surface covered with small papilla and small oblong unequal pores.

3. *Spongia cespitosa*, Raf. (Bushy sponge.) Branched, cespitose, yellowish, rough, papillose; branches fasciculated, upright, unequal, flexuose, compressed, slightly anastomosed, nearly dichotome upwards; cells porose, oblong, nearly equal, margin lacerated.

Found also on the oyster, but more seldom than the foregoing; the specimens which I saw was found on the Bluepoint oysters, by Dr. Eddy. It becomes brown by drying. It rises from four to six inches, the margin of the cells or pores is torn into papillar, stiff processes, which produce a rough surface. Substance stripose. Internal cells oblong, very small.

4. *Spongia cladonia.* (Cladonian sponge.) Branched effuse, smooth, pale fulvous, stem procumbent, branches distichal, one-sided, erect, simple or divided, obtuse; cells porose, minute; some larger round.

I have found this species at Bath and at Sandy-Hook, on Sandy bottoms. Length about six inches. Stem and branches cylindrical or compressed. Substance fibrose, anastomed, branches divaricate, ascendent, semi dichotomose or simple, unequal, thicker towards the top.

5. *Spongia virgata.* (Slender sponge.) Nearly branched, smooth, fulvous, stem divided, slender, cylindrical, knobby, branches erect, slender, nearly heads acute; pores unequal, irregular, small. [151]

A small species, three inches high, found at Oysterbay, on rocky bottoms, rare; stem with few branches, and imperfect ones, like knobs. Substance stupose. Branches round, alternate, small. Pores without any determinate shape.

Art. XII. *Memoir on the Xanthium maculatum, a New Species from the State of New-York, &c. by* C. S. Rafinesque, Esq.

Pursh and Michaux mention only one species of American *Xanthium*, the *X. strumarium*, while there are three noticed in the catalogue of Dr. Muhlenberg, the above species, and the *X. orientale*, and *X. spinosum*. The first and the last are natives of Europe, and have been naturalized in the United States, with many other plants. The species called *X. orientale* by Dr. Muhlenberg, appears however to be a native; but the *X. orientale* of Linnæus, is a native of Siberia, Japan, and the East-Indies; and when plants are found to grow in such opposite quarters of the globe, a strong presumption arises that they are not identical species, which presumption has been confirmed by experience in many instances, whenever the plants of both countries have been accurately examined. Decandolle, in the French Flora, (2d edit, of 1815.) vol. 6. p. 356, describes, under the name of *X. macrocarpon*, a species found in France, and which he takes to be the real *X. orientale* of Linnæus. He has changed its name, because, he says, that it is not certain that the *X. orientale* grows in Asia; or, if any grows there, that it is identic with his species; which, however, is really the *X. orientale* of Linnæus, Son, Lamark, and Gaertner. He adds, that he possesses in his herbarium, a species from Canada, different from his *X. macrocarpon* which has been figured by Morison, on whose authority some authors have asserted that the *X. orientale* grew in Canada, mistaking his figure for that plant.

From the above statement, it appears that much obscurity and difficulty arises in botany, when [152]
errors creep into the distinction of species: to detect those errors, and to ascertain the synonyme of obscure species, is not one of the least useful botanical labours. Having found, last year and this year, in the neighbourhood of New-York, a species of *Xanthium* different from any described by the authors, and intermediate between the *X. strumarium* and *X. orientale* of Linnæus, I presume that it may be the *X. orientale* of Muhlenberg, Leconte, and Morison, and the *Xanthium* of Canada, mentioned by Decandolle, Dumont, &c. I have given to it the name of *X. maculatum*, since the stem is spotted like the *Conium maculatum*. None of those authors having described it, I suppose that its description will be acceptable, and will serve to fix this new species among the American botanists.

Therefore it will appear, that the *X. orientale*, which had been considered as a native of Asia, Europe, and America, is composed of at least three species; the European species, which has been called *X. macrocarpon* by Decandolle, the American species, which I have called *X. maculatum*, and the Asiatic species, to which the name of *X. orientale* ought to remain; but which ought to be better described, and more fully distinguished from the *X. macrocarpon* by those who may chance to meet with it. I even suspect that many species grow in Asia, since that of Ceylon may be different from the Chinese and Siberian species.

Xanthium Maculatum.

Definition. Stem flexuous, round, rough, spotted with black; leaves long-petiolate, cuneate-reniform, nearly trilobe, sinuate-toothed, obtuse, rough, and thick; fruits elliptic, obtuse muricate; thorns rough.

Description. The root is annual, thick, and white. The stem rises from one to two feet; it is upright, without thorns, very thick, and with few branches; it is covered with oblong, black, and rough spots. The leaves are few, but large, with very long petiols; they are nearly reniform, with an acute base, and have three nerves; the teeth are unequal, large, and obtuse. The flowers and [153]
fruits are disposed as in *X. strumarium*; but the fruits are generally solitary; they are half an inch long, nearly cylindrical obtuse, with the two beaks scarcely perceptible and bent in, covered with short, thick, and rough thorns, rather soft, and not uncinate. The whole plant has a peculiar smell, not unpleasant, somewhat between the camphorate and gravulent odour, but weaker than in *Conysa camphorata*, &c.

History. This plant grows on Long-Island, near the seashore and marshes. I have found it common near Bath, on the downs, and in New-Jersey, near Bergen, and Powles Hook, on the margin of marshy meadows. According to Dr. Mulenberg, it grows also in Pennsylvania; Messrs. Torrey and Leconte found it on the island of New-York; and by Morison and Decandolle's account, it is found as far north as Canada. It blossoms in August and September, but the fruits remain on the plant till the severe frosts of December.

Observations. This species differs from the *X. macrocarpon* of Decandolle, by having smaller fruits, without horns, and whose thorns are neither hooked nor hispid; by not having an angular stem, but a round, spotted one, and by its leaves being broader, and not serrate, &c. Nearly all those differences exist between it and the *X. orientale* of Asia, which has not yet been isolated from the *X. macrocarpon*. The *X. edrinatum* differs from this by having oval fruits, with aggregated, echinate, and hooked thorns; and the *X. strumarium*, by having cordate hirsute leaves, the fruits aggregated, with hooked thorns and horned tops. The *X. spinosum*, and *X. fruticosum*, ate so totally different that they need not be compared.

ART. XIII. *Description of the Phalaena Devastator, (the Insect that produces the Cut-worm,) communicated for the American Journal of Science, &c. by* Mr. JOHN P. BRACE, *of Litchfield, Conn.*

This moth, whose larva is one of our most destructive enemies, belongs to the Linnæan family noctua, in the genus phalaena. Its specific characters are as follow: Wings incumbent and horizontal, when at rest; body long and thin; thorax thick, but not crested; head small; eyes prominent and black; antennæ setacious, gradually lessening towards extremities, and slightly ciliated; palpi two, flat, broad in the middle, and very hairy; tongue rolled up between them, not very prominent; clypeus small, legs long, small and hairy; wings long as body; under wings shortest; colour a dark silvery gray, with transverse dotted bands of black on upper wings. The insect lays its eggs in the commencement of autumn, at the roots of trees and near the ground: they are hatched early in May. The habits of the cut-worm have been often and fully detailed. They eat almost all kinds of vegetables, preferring beans, cabbages, and corn. They continue in this state about four weeks; they then cast their skin and enter the *pupa* state, under ground. This is a crustaceous covering, fitted to the parts of the future insect. In this they continue for four weeks longer, and come out in the fly, or insect state, about the middle of July. All those chrysalids that I exposed to the sun, died; and all those that were kept cool under earth, produced an insect: hence I infer, that the heat of the sun will kill the chrysalids. If, then, the ground be ploughed about the first of July, many of those insects might be destroyed, and the destruction of the productions of the next year prevented; for the *pupa* is never more than a few inches under ground.

The phalaena devastator is never seen during the day; it conceals itself in the crevices of [155] buildings, and beneath the bark of trees. About sun-down it leaves its hiding-place, is constantly on the wing, and very troublesome about the candles in houses. It flies very rapidly, and is not easily taken.

Such is the description of this formidable enemy to vegetation. No efficacious method has yet been taken to prevent its ravages, but the one who could accomplish it, would do the cause of agriculture an essential service.

ART. XIV. *Description of a New Genus of North American Fresh water Fish, Exoglossum, by* C. S. RAFINESQUE, ESQ.

Mr. Lesueur has published, in the 5th Number of the Journal of the Academy of Sciences of Philadelphia, for September, 1817, the description of a new fish, which he calls *Cyprinus maxillingua*: he considers it as a very singular and anomalous species, owing to the peculiar structure of its lobed lower jaw and tongue, which is external, and situated as an appendage to the former. It was discovered in Pipe-creek, Maryland, in June, 1816, by said author, who confesses that he does not consider it as properly belonging to the genus *Cyprinus*, and presumes that when other species shall be discovered, possessing the same character, they will constitute a separate genus. Although this principle and presumption is correct, it was wrong to delay the formation of such a distinct genus, because only a species was then known, since so many genera are composed of single species. However, Mr. Lesueur's expectation was verified even before he wrote it, since in May, 1817, I had discovered in the Fishkill, State of New-York, another, species, evidently congenerous with the *Cyprinus maxillingua*, having the same structure of the mouth, &c. I therefore venture to establish a separate genus for those two species, having no doubt that many more will hereafter be added to it by accurate observers, and I give to it the name of [156] *Exoglossum*, meaning *outside tongue*. It will belong to the same natural order and family of the genera *Cyprinus*, *Catostomus*, &c.

EXOGLOSSUM. *Generic Definition.*—Body oblong, thick, and scaly; head without scales, mouth without lips or teeth, upper jaw longer, entire; the lower trilobed, middle lobe longer, performing the office of tongue; dorsal fin opposite to the abdominal fins; three rays to the branchial membrane.

Remarks. Besides the above characters, the two species known at present have, in common, the lateral line ascending upwards at the base, the tail forked, &c.

1. Species. *Exoglossum vittatum*, Raf. *Cyprinus maxillingua*, Lesueur. *Specific Definition.*—Back brownish olive; sides blue, with a brownish band; a black spot at the base of the caudal fin, lower parts silvery gray; lateral line ascending upwards at the base; dorsal and anal fins with nine rays; tail forked.

Remarks. Length four inches; vulgar name *little sucker*. For further particulars, see Lesueur's description, p. 85. cum. ic. I have been obliged to change the specific name of *maxillingua*, since it has the same meaning as the generic name.

2. Species. *Exoglossum annulatum*, Raf. Head black above, cheeks and gills olivaceous, back blackish olive, sides olivaceous, lower parts olive gray; a black ring at the base of the tail; lateral

line ascending upwards at the base, tail forked, dorsal and anal fins with nine rays.

Remarks. Length from three to six inches; vulgar name, *Black chub*. Head broad and flat above, iris large and gray; fins olivaceous, abdominal distant and with nine rays, pectoral with fifteen, caudal with twenty-four.

Art. XV. *On the Revolving Steam-Engine, recently invented by* Samuel Morey, *and Patented to him on the 14th July, 1815, with four Engravings*.

To Professor Silliman.

Sir,

The successful employment of the steam-engine, in navigating the rivers and inland waters of the United States, and the probable extension of this mode of conveyance of persons and property, makes those improvements desirable which adapt the steam-engine to this purpose with less complication and expense, placing it more within reach of individual enterprise, and rendering it even useful on our small rivers and canals.

The steam-engine, though often seen in operation, is not readily understood by an observer, without an acquaintance with the facts in natural philosophy on which its power depends: and it may elucidate the subject of this communication to advert, for a moment, to the gradations by which this important machine has attained its present perfection.

It will be recollected that as early as 1663, the Marquis of Worcester published some obscure hints of a mechanical power derived from the elastic force of steam.

In 1669, Savary, availing himself of the suggestion, and pursuing the subject more scientifically, invented his engine, consisting of an apparatus to cause a vacuum by the condensation of steam, so that the water to be raised would thereupon, by the external weight of the atmosphere, rise into the chamber of the apparatus, which the steam had occupied.

As caloric becomes latent in the steam which it forms at 212° of Fahrenheit, and the steam thus formed occupies 1800 times the bulk of the water composing it; and as it returns instantly to a [158] state of water on losing its heat, by contact with any thing cold, Savary easily produced his vacuum by the injection of a little cold water.

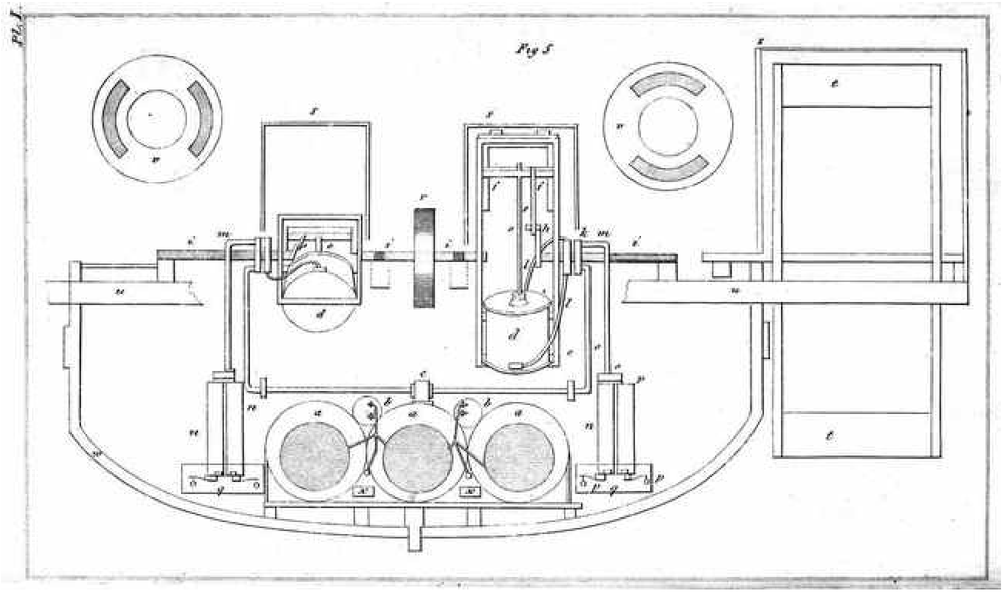
He also used (though in a very disadvantageous manner) the expansive force of steam to drive the water out of the chamber, through a pipe different from that by which it entered.

It is doubtful whether this kind of engine was ever erected on a scale of any magnitude; for, a few years later, Newcomen and Crawley invented the first engine with a cylinder and piston; and Savary, abandoning his own, united with them in bringing their engine into use.

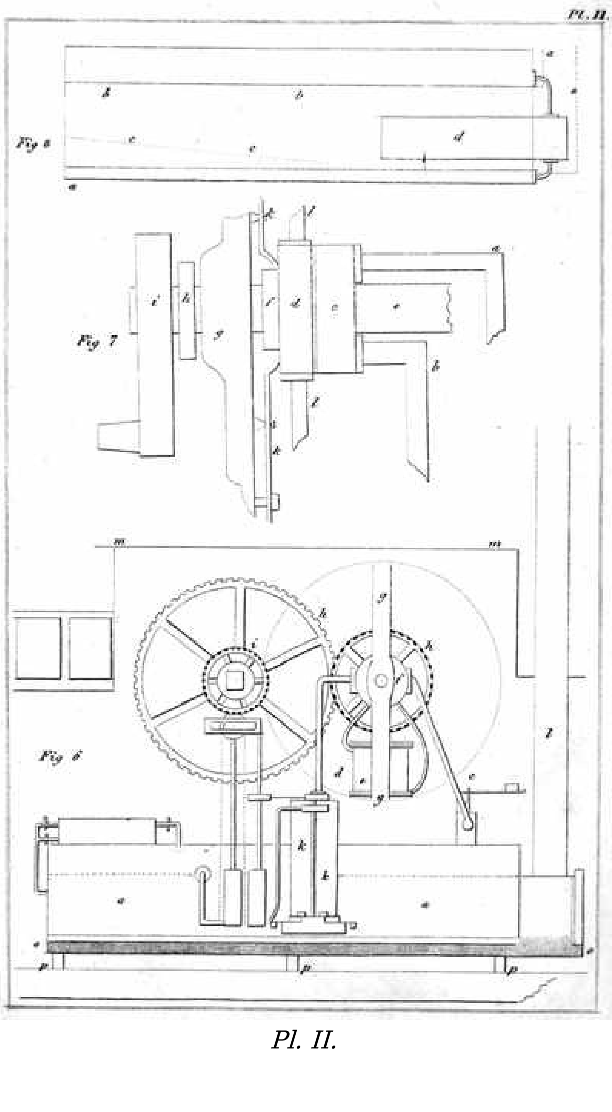
As steam drives out air, the principle of this engine was to let steam into the cylinder beneath the piston, where (the piston having risen to the top of the cylinder) a jet of cold water[22] condensed the steam, produced a vacuum, and the piston, working air tight, descended by the pressure of the atmosphere upon it, this pressure being a weight of nearly fifteen pounds to each square inch; so that if the cylinder were two feet diameter, it would amount to a weight of three tons.

This mode of operation prevailed for about fifty years, and though much used to pump water from mines, was found to have great inconveniences and defects; till, in the year 1762, Mr. Watt, being employed to repair a working-model of an engine at the University of Glasgow, was led to direct his mind to the improvement of the machine; and from his experiments sprung the most essential change, viz. the condensation of the steam in the cylinder, by opening a communication with a separate vessel, into which the injection of cold water was made, thus allowing the cylinder to remain hot.

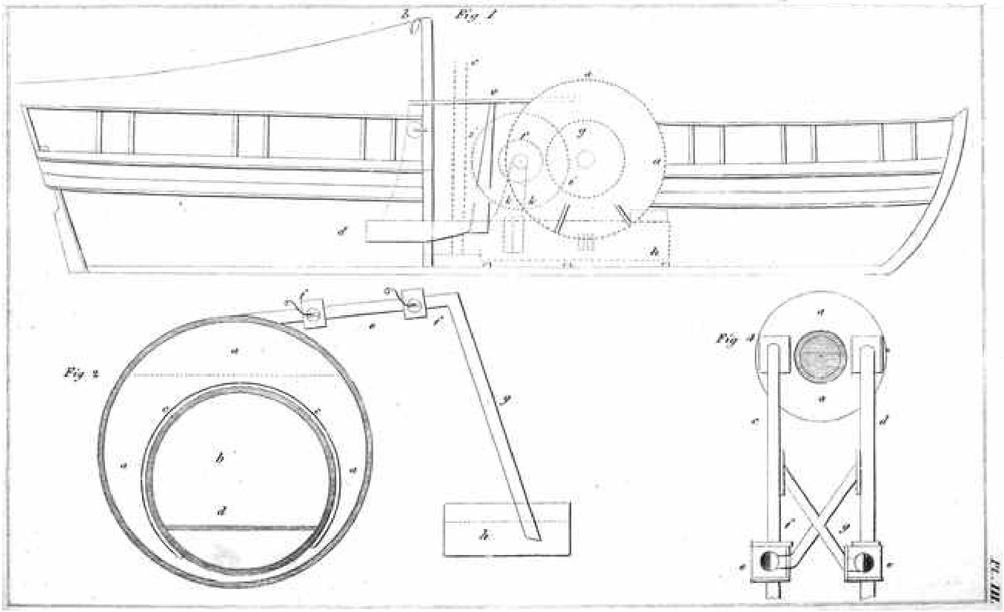
On opening that communication, the steam instantly rushes to the cold, or rather is destroyed by the instant loss or reduction of its heat, and the vacuum thus made allows the piston to descend as before mentioned.



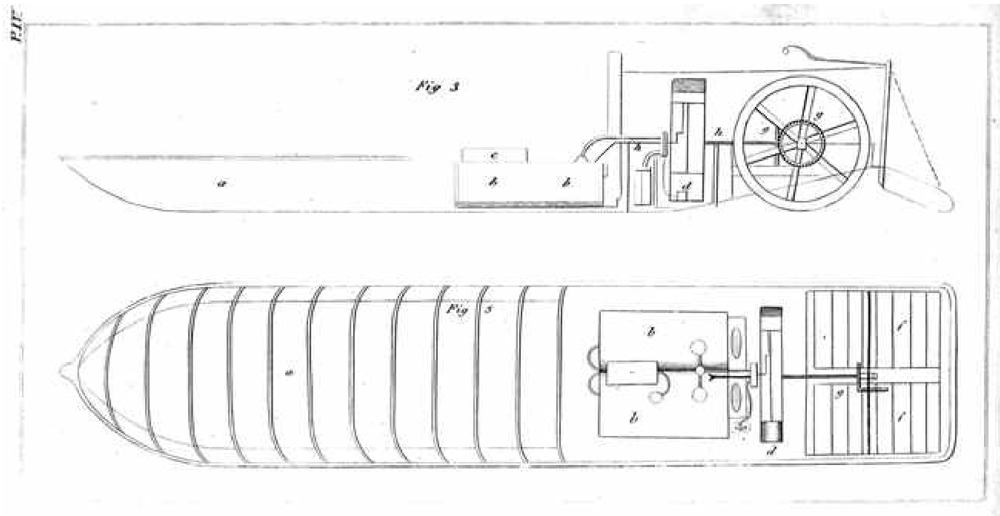
Pl. I.



Pl. II.



Pl. III.



Pl. IV.

Mr. Watt soon added the airpump to the condenser, to extract the air extricated from the water [159]
in boiling, together with the water injected.

The next step was to close the upper end of the cylinder, the piston-rod working through a tight packing to exclude the air, letting the steam in above, as well as below the piston, by an alternate communication, and then condensing it in both cases alternately, thus producing a double stroke; at the same time deriving some aid from the expansive force of the steam on the side of the piston opposite to the vacuum. This is essentially the form of all the engines in use at the present day. The minor parts devised by Mr. Watt, as the working of the valves, &c. were such as would readily occur to a scientific mechanician.

While he was bringing the engine to its present perfection, and furnishing it for the numerous mines, manufactories, and breweries in Great Britain, variations were devised by Cartwright, by Hornblower, Woolf, and others in England, and more recently by Evans and by Ogden in America, evincing much ingenuity, but (with the exception of Evans's, which is a simple engine of high pressure) making the machine more complex.

Watt and Bolton's engine, as most generally used, being properly an atmospheric engine, or working with steam so low as merely to produce a vacuum in the cylinder, became of enormous dimensions, when the power required was that of an hundred horses: a scale of estimate adapted to the comprehension of those who had before used the labour of that animal, and preferred to substitute the steam-engine.

It had not, however, escaped the notice of Mr. Watt, that there existed in steam another source of power besides that of atmospheric pressure. The experiments of his learned friend, Dr. Black, of Glasgow, as well as those of the French chemists, and of Papin, in the instance of his digester, had ascertained the laws of its expansive force, and amongst other interesting facts, those subservient to our present purpose; viz. That after water has reached the boiling point, 212° of
Fahrenheit, the caloric which enters it no longer becomes latent, but sensible in the steam, which [160]
thereupon acquires expansive force to an unlimited degree: that this force increases geometrically; or, that every accession of about 30° of heat, nearly doubles its power at those

stages of progression; that when the pressure at a high temperature is taken off, or the steam allowed to flow, there is an instantaneous and rapid production of steam; a fact which proves there can be no necessity of a large space for the steam to form in above the water, provided it be sufficient to prevent water from issuing with the steam, and, therefore, that boilers of a small cylindrical form are best.

It may be a fair question, why Mr. Watt did not further employ this principle of expansive force? We may readily conceive of several motives to the contrary. Watt and Bolton's engines were in great demand; they gave entire satisfaction, and the work they performed saved so much labour as to afford the purchase at a high price. The public had gained immensely by this better form of the engine, and Mr. Watt enjoyed the benefits of the patent he had obtained; and, at a later period, this preference was increased by an accident which happened to Trevethick's engine, though caused by gross mismanagement, that would have been equally fatal to any other.

From an investigation, by a committee of parliament, into the causes of the several fatal explosions of steam-engine boilers within a few years, published in Tillock's Magazine, vol. 1., it appears that in every instance the accident was fairly attributable to neglect or mismanagement. Many competent persons were summoned to give their opinions; and through the contrariety of their testimony, the prevalent opinion appears to have been, that cast-iron boilers cannot be safe; that as many engines of high steam as of low are now used in England, but that the high are much the most economical in fuel and cost; that they are more safe, if properly constructed; it being argued by some, that boilers for steam of 100 pounds to the inch, are easily made of strength to sustain 500 pounds; this excess being much greater than in those constructed for low steam, makes them comparatively the safest, as the safety valves are less liable to be accidentally prevented from venting the steam.

In the United States, instances are not wanting of the successful operation of high steam; of [161]
which the engine at the mint is a conspicuous example. There can, indeed, be no good reason why this great power should not be employed to an extent within the limits of safety, if more economical and convenient. If boilers can bear (as they are usually made of iron) 500 pounds, there can be no danger in using them with fifty; and this gives an increase of power, with a condenser, fourfold, or makes a ten horse power forty. The economy, therefore, of high steam, hardly admits of a question. It seems unphilosophical to neglect a power so great, merely because it is so.

Mr. Watt was desirous of an improvement by which to obtain a direct rotatory motion. His experiments, resembling those of Curtis, at New-York, were not found permanently practicable.

It was probably perceived to be a great object to get rid of a reciprocating movement of large masses, on the well-known mechanical principle, that it consumes power to check momentum, as well as to give it—to drag an inert mass into motion rapidly, in opposite directions. And in engines for navigation this is more disadvantageous than for land uses, as the foundation of the engine cannot be perfectly substantial.

An engine, therefore, that possesses the cylinder and other members of Watt's engine, working with or without a condenser, at pleasure—having a rotatory movement—requiring no ponderous balance-wheel—adapted to high steam—attended by no inconvenience from the rapidity of its stroke or movement—having no inert mass of machinery to move reciprocally—more powerful, proportionately, from its using steam as strong as that in the boiler—of a simple and durable construction, and by a combination of two similar machines attached to the same common intermediate axis, operating so as to give nearly an equal power at every moment of its operation, seems to combine every thing desirable in an engine for the purposes of navigation. Such appears to be the revolving engine invented by Mr. Morey.

When those who are acquainted with steam-engines of the atmospheric kind only, are told that [162]
Morels cylinder revolves, their imaginations may suppose a moving mass as large as the enormous cylinders they have been accustomed to see: but it is not so; the elastic force of steam requires machinery but of comparatively small dimensions.

The revolving engine makes up in activity what in other engines is supplied by magnitude.

We will take for example the engine working at the glass manufactory, in this vicinity, the cylinder of which has one foot stroke and nine inches diameter, and is at least a ten horse power, working with fifty pounds—or, the engine now building for the Hartford boat. This engine will have two cylinders of seventeen inches diameter and eighteen inch stroke; they will revolve fifty times a minute. The area of the piston in each being 227 inches, steam at fifty pounds will give an hundred horse power.

This boat is seventy-seven feet long, twenty-one feet wide, and measures one hundred and thirty-six tons. The engine, with its boilers, will occupy sixteen feet by twelve, or one-eighth only of the boat; the cylinders being hung on the timbers of the deck over the boilers. She is principally intended to tow vessels up the river to Hartford.

In towing, it is of importance that the engine admit of any inferior velocity or power, till some momentum is had. An engine working by atmospheric pressure does not admit of this. And as the boat herself, at the moment of commencing the operation, may have no steerage-way, by placing two blade-rudders at the sides, behind the water-wheel, where a current is occasioned by them, the boat is kept in her relative position.

The application of the steam-engine to the towing of other vessels was fully appreciated by the late Mr. Fulton, whose conspicuous labours and enterprise, in the establishment of steam-boats, the public duly honours. His active mind had conceived of its utility; and he would have obtained a patent, had not the previous employment of steam in this way, and the award of arbitrators on the question been in my favour; which I mention merely in reference to the supposed utility of this mode of operation, in connexion with Morey's engine. [163]

Morey's engine should rather be denominated a revolving engine than a rotatory one, especially as it is essentially different from one so called invented by Mr. Curtis.

Plate I. Fig. 5, represents the arrangement of a double engine for a boat, with its cylinders in different positions. *a a a*, boilers; *b b*, tar-vessel; *c*, valve-box; *d*, cylinders in different positions; *e*, piston-rod; *f*, pitman; *h*, centre-piece; *i i*, shaft; *k*, valve; *l*, steam-pipe; *m*, escape-pipe; *n*, condensers; *t*, water-wheel; *v*, face of the valves; *x*, tar-fire. The frame, holding the cylinder (*d*) is, by its opposite sides, so hung as to revolve. To the end of the axis of one side, extended over the cylinder, is fixed the centre-piece (*h*) resembling a crank, from which the bar or pitman (*f*) communicates to the cross-piece of the piston-rod. On this same axis, but outside the frame, is placed two circular pieces, one of brass, the other of iron, (*k*) which we may call the valves. One is fixed on the axis, the other moves, and accompanies the frame and cylinder in its revolution; from it, at opposite sides, pipes lead the steam to each end of the cylinder. It has a smooth face, which applies, and is kept by springs close to that of its counterpart fixed on the said axis. Steam-pipes lead from the boilers through the counterpart into the moving valve. On the opposite side of the fixed piece the eduction-pipe (*o o*) leads to the condensers.

The condensers (*p*) are upright vessels, two to each cylinder, connected at top by a sliding valve box, so that the steam enters them alternately. At bottom are two valves, kept closed by weights. A stream of water is injected into the condensers, which escapes by the bottom valves (*p p*) by which also the air is blown out, at every stroke, in the same manner the engine is cleared of air at first.

There are also two cocks and cross-pipes seen, Plate III. Fig. 4, to change the steam from one side to the other of the valve, to give a reversed motion of the engine.

The power is communicated to its object from the opposite side of the frame by the axis attached thereto, and supported on bearings. This axis (*i i*) may be of any length; may terminate [164] in a crank or cog-wheel, or another cylinder (as here represented) may be attached thereto at right angles to the first, to co-operate and produce, at every moment, equal power.

Plate II. Fig. 6. Profile of the above. *a a*, the boiler; *c*, valve; *d e g*, cylinder and frame; *f*, valve; *h h*, cog-wheels; *i*, cog-wheels to move the pumps; *k k*, condensers; *m m*, coverings in; *o o*, gas-fire flue.

Fig. 1. *a*, steam-pipe; *b*, escape-pipe; *c*, fixed valve; *d*, moving valve; *e*, axis; *f*, a washer; *g*, section of frame; *h*, a washer; *i*, centre-piece; *l l*, steam-pipe; *k k*, springs to keep the valves together.

The canal-boat has her wheel in the stern. (See Plate IV.) The motion is given by a cog-wheel upon its axis (*g*) played upon by another, upon a shaft, at right angles, to which the engine communicates motion. The wheel being divided by a space of two or three inches, into two parts, to allow room for this shaft, and for the support of its end.

Fig. 3, represents the arrangement of the machinery, occupying the after-part of the boat. An engine of twenty horse power may thus occupy half a canal-boat, can tow a number of others at such rate as may be proper on canals.[23] *b b*, the boilers; *c*, tar-vessel; *d*, the cylinder; *f*, water-wheel.

The supply of water to the boilers is either by a pump, in usual form, or by the *supply-chamber* of my invention, (Plate III. Fig. 2.) which consists simply of a pipe having two stop-cocks, one end in a reservoir, the other opening into the boiler at top, sloping downward for a foot or two. The cocks are in the sloping point. The operation commences, by opening the cock nearest the boiler, the steam drives the air out of the pipe through the water into the reservoir; shut the cock, and the water rises from the reservoir to fill it; shut the second cock, and open the first, the water [165] discharges from the chamber into the boiler; repeated by a movement from the engine, when in motion, the supply continues with more certainty than by a pump, because it is difficult to pump hot water, on account of the elasticity of the steam arising from it, which obstructs the operation of the valves. And it is important not to have to pump against the pressure of high steam.[24]

Plate III. Fig. 4. The mode of changing the passage of the steam to the opposite sides of the valves, in order to get a reversed motion of the engine. *a a*, the fixed part, or valves; *c d*, the pipes; *f g*, the cross pipes; *e e*, the cocks, which are represented open, to pipes *c* and *d*—turn them half round, they close *c* and *d*, and open *f* and *g*. Fig. 1 shows the side-rudders, *d*, *e*, &c.

To this engine is conveniently applied the gas-fire, in the following manner.

The boilers being cylindrical, with an inside flue for fuel, two or three are placed close together, and set in the following manner: First, cross-bars of iron are laid on the timbers, a platform of sheet-iron is laid on these bars, coated over with clay mortar, or cemented, to keep out the air. Upon the sheet-iron, and over the bars below, are placed cast-iron blocks in shape to fit the curve of the boiler, so as to raise it three or four inches above the platform. The sheet-iron is continued up the outsides of the outer boilers, so as to enclose them; and at one end, between the boilers, there are small grates for coal or other fuel.

The tar vessel or vessels, as the case may be, are lodged in the space between and upon the boilers, and a small fire may be made under them, if necessary. A pipe leads steam in at one end, two pipes at the other; one near the bottom, and one near the top, lead out the tar and steam.

These pipes unite below; the steam and tar, thus mingled in suitable proportions, flow to the main fire, or the flues of the boilers, as well as to the coal-fire below, where the gas and tar are ignited. The fireman judges of the proportion of each, by the effect; the object being to produce a nearly white flame without appearance of tar. Thus flame is applied to the greatest possible surface, and the apparatus adds very little to the cost of the engine. [166]

There are also two improvements in the boiler, which I deem it important to mention. First, the lining or covering of the flue within with sheet-iron or copper, *perforated with small holes*, reaching down its sides, nearly to the bottom. Plate III. Fig. 2. *a* the boiler; *b* the flue; *d* the grate; *c c* the lining.

This causes the water to circulate rapidly between them to the top of the flue, and protects it from being run dry, or heated red hot, when the water gets, by accident, too low. The lining also *causes the steam to form much faster, in consequence of this circulation*.

The other is the interior boiler. A vessel occupying the back part of the flue. Plate II. Fig. 8. (*d*) communicating downwards with the water, and upwards with the steam of the main boiler. The fire acts upon it very forcibly, surrounding it on all sides.

I have said there is no reciprocating movement in Morey's engine. Should it be objected that the piston moves in the cylinder as usual, it must be apparent that it also moves circularly; it is in fact the cylinder that moves, carrying the piston with it, which gives and keeps up the motion, by drawing and pressing on the centre-piece, and communicating the resistance thence to the *guides* of the cross-piece on the insides of the frame, which thus receives its motion.

In fact, this form of the engine seems divested of all the usual drawbacks on its power, and leaves it to act freely with any velocity, according to the strength of the steam in the boilers.

Such it appears in principle, and such thus far in practise. I have therefore preferred it for the purposes of navigation, and have purchased the patent right. But, though interested to recommend it, I cannot expect it to be preferred by the intelligent, if there is not merit in the invention, and great economy in its use. It may be considered the most direct application of the power, and the most unexceptionable mode of using the expansive force of high steam. And from the nature of its movement the most applicable to boats and vessels. [167]

Your Journal being the intended medium of information to promote the useful arts, I hope it may be consistent with this object to explain the manner in which these improvements may be made extensively useful.

It being necessary to supply the engines at a reasonable rate, I have established a manufactory for this kind only. The great expense of steam-boats hitherto, has confined their use too exclusively to the accommodation of passengers. There is a wide field opening for their use, in freighting, on all our waters; and it is often of importance to a community, when great savings can be made, that large capitalists should be induced to engage that such savings may be greater. Where companies are formed for an extensive operation, the legislature may, with propriety, grant an extension of the time for patents to run, that such persons may be duly remunerated for their enterprise, by the duration of the service.

Our laws do not yet make a proper distinction between patents of a large and expensive kind and those requiring little or no capital to go into operation. The period of fourteen years remunerates the inventor of those improvements only that require no capital, and involve no risk.

On this ground several of the State legislatures have, with good policy, given encouragement to this kind of enterprise. They suspend the free use of the invention a few years, rather than loose its immediate operation on a large scale of public benefit.

The constitutionality of the measure plainly appears by its not interfering with the laws of the United States. It is not an act exclusive of, or in opposition to, patents, but acknowledging and confirming them. It is furthering and giving effect to the intentions of the general government, in the encouragement of useful inventions. For their own particular section of the union, a State legislature may thus provide for the protection of capital, engaged in enterprise of uncommon risk, as well as of uncommon usefulness, without excluding other and better inventions, should they arise. [168]

I shall ask leave to communicate, for some future Number, the results of experiments, now making, with the gas fire applied to engines.

I am your most respectful humble servant,

JOHN L. SULLIVAN

Art. XVI. *Cautions regarding Fulminating Powders.*

Fulminating Mercury.

During a late lecture in the laboratory of Yale College, a quantity of fulminating mercury, probably about 100 or 150 grains, lay upon a paper, the paper lay on a small stool, which was made of pine plank, *one inch and a half thick*; a glass gas receiver, 5 or 6 quarts capacity, stood over the powder, as a guard, but without touching it, and stool and all stood on one of the shelves of the pneumatic cistern, surrounded by tall tubes and other glasses, several of which were within 6 or 8 inches. A small quantity of the fulminating powder, at the distance of a few feet, was merely flashed, by a coal of fire, but without explosion. In a manner, not easily understood, the whole quantity of powder under the large glass instantly exploded with an astounding report; *but the glass was not exploded*—it was merely thrown up a little; in its fall it was shattered, and broke a glass which it hit, but no fragment was *projected*, and none of the other contiguous tubes and glasses were even overset, nor were any of a large audience, and some of them very near, even scratched; *but the plank, one and a half inch thick, on which the powder lay, had a hole blown quite through, almost as large as the palm of one's hand*. This is a striking instance to prove that the *initial* force of this powder, when exploded, is very great, but that it extends but a very little way. If it be strewed through a glass tube of three-fourths of an inch in diameter, and [169] exploded by a coal of fire or hot iron, the tube may be held in the naked hand, and the powder only flashes without breaking the tube, and merely coats it over inside, and that very prettily, with the revived quicksilver.

Fulminating Silver.

Chemists are too well acquainted with the tremendous energy of this preparation, to make any comment upon its powers necessary. Unhappily, however, it is now made a subject of amusement; it is prepared for sale by those who know nothing of it, except as a nostrum, and it is bought by others who have not even this degree of knowledge. It is true it is put up in small quantities, in the little toys called torpedoes, and, if exploded one by one, they will ordinarily do no harm; but as they fall into the hands of children, we can never be secure that they will be discreetly used.

A very severe accident, from the unexpected explosion of this substance, occurred some years since in the laboratory of Yale College. (See Bruce's Journal, Vol. I. p. 163.) And, notwithstanding that this occurrence was well known in New-Haven, the same accident, only under a severer form, has again occurred in that town.

A man who had bought the secret of making fulminating silver, had prepared as much as resulted from the solution of one ounce and a half. Apparently, in a great measure, unaware of the nature of the preparation, he had placed it, unmixed with any thing, on an earthen plate, which stood on a table; his wife and children being around, he sat down to distribute the powder upon several papers which he had prepared for the purpose; sand and shot are mixed with the powder in the papers for the purpose of giving momentum, and of producing attrition when the torpedo is thrown, in order to ensure its explosion. Probably also the sand, looking not very unlike the powder, may be intended to screen it from view, and thus to preserve the secret, should the papers be opened. The unhappy man no sooner touched the fulminating silver with a [170] knife, than it exploded with its usual violence; the table was split in two; blood issued copiously from every part of his face, not from wounds, for it does not appear that the fragments hit him, but, according to the opinion of a competent judge, the blood was actually forced through the pores of the skin by the power of the explosion, which very nearly destroyed his eyes. He suffered immensely, but now, at the end of eight months, sees partially with one eye, but the other is nearly, if not quite, destroyed.

Should not the tampering with such dangerous substances by ignorant people be prevented by law?

In a late lecture in the laboratory of Yale College, some fulminating silver, on the point of a knife, was in the act of being put upon a copper-plate connected with one pole of a galvanic battery in active operation, the other pole was not touched by the experimenter; but it seems that the influence which was communicated through the floor of the room was sufficient instantly to explode the powder, as soon as the knife touched the copper-plate; the knifeblade was broken in two, and one half of it thrown to a distance among the audience.

Recently also, we are informed, in one of the foreign journals, that a man in England, who accidentally trod on a quantity of fulminating silver, had his foot nearly destroyed by the explosion.

Art. XIX. *Account of an economical method of obtaining Gelatine from bones, as practised in Paris. Communicated to the Editor by Mr.* Isaac Doolittle.

Paris, 16th May, 1818.

My dear Sir,

A few days since I visited the very interesting establishment of M. Robert, for the extraction of the gelatinous matter from bones.

The bones used for this purpose are those only which answered no useful purpose (except for the fabrication of phosphorus or ammoniac) before this discovery, such as those of the head, the ribs, &c. &c., the legs of sheep and calves, &c. Those formerly used by *toysmen* (*Tabletiers*) are still used for that purpose, after extracting so much of the gelatine as can be done by ebullition. [171]

When the heads of oxen are to be operated upon, they begin by extracting the teeth, (these are reserved for the fabrication of ammoniac, as affording a greater proportion of that alkali than any of the other bones,) they then break the skull, in such manner as to preserve all the compact parts in as regular forms as possible; these pieces present a surface of 20 to 30 square inches, and are put to soak in a mixture of muriatic acid and water. The muriatic acid used bears about twenty-three degrees o£ the *aeromètre*, and is diluted by water to about six degrees—four parts of the liquor is used to one part of bones. They are left in this state, in open vessels, until a complete solution of the phosphate of lime has taken place, and the gelatinous part of the bone remains in its original shape and size, and is perfectly supple. When this operation is finished, which commonly lasts six or eight days, the gelatine is put into baskets, being first drained, and immersed a short time in boiling water, in order to extract any small remains of grease, which would deteriorate the gelatine, and also to extract any of the acid which might be lodged in the pores. It is then carefully wiped with clean linen, and afterward washed in copious streams of cold water, to whiten it, and render it more transparent; it is then put to dry in the shade.

Two ounces of this gelatine are said to be equal to three pounds of beef in making soup—that is, three pounds of beef and two ounces of gelatine will make as much soup, and of as good quality, as six pounds of beef. It is constantly used in some of the hospitals of the capital, particularly in the lying-in-hospital.

The ends of the bones, and such parts as from their porosity might still retain a portion of the acid, are separated, and used for making glue of a very superior quality.

The inside of the bones of sheep's legs furnish a sort of membranous glue, which supplies, with advantage, the place of isinglass in the fabrication of silk stuffs. [172]

I give you these particulars, not because I think they contain any thing new to you, *in principle*, but because I may have hit upon some *details* with which you were unacquainted.

Art. XX. *Experiments made in France upon the Use of Distilled Seawater for domestic purposes, and its Effects on the Constitution, when taken as a Beverage.*[25]

In consequence of the great want of good fresh water in many of the maritime parts of France, the government some time since ordered some experiments to be made, upon an extensive scale, in order to ascertain how far seawater, when distilled, could be used with success. Little or no use had hitherto been made of water so prepared, except in long voyages, and chiefly then only as a matter of necessity. There are above two hundred leagues of seacoast in France, where, to the breadth of many miles, the inhabitants are compelled to make use of bad and impure water, which, in many cases, is injurious to the health of themselves and their animals. In similar cases, it was the custom of the ancients to construct cisterns; but these are not only expensive in themselves, but their utility depends upon the quantity of rain that falls; while upon the shores of the most barren places, nature has supplied a variety of vegetable matter, which, when dried, would not only serve as a fuel for the purposes of distillation, but from the ashes of which might be obtained a saline substance, sufficient to repay the expense of collecting, drying, and burning. Thus the fuel for the distillation of seawater would, in reality, cost nothing, while its preparation would employ many individuals, particularly women and children. Before, however, erecting any apparatus for this purpose, it was necessary to ascertain both the utility and salubrity of the water thus prepared. [173]

It is well known that Bougainville, Phipps, Homelin, &c. had employed this water with much success; but they, like most of the chemists of the last age, did not endeavour to imitate the process of nature in all its simplicity, but mixed various substances with the seawater, in order to take away or lessen the effect of the empyreuma arising from the distillation, and which was so unpleasant to the smell and taste. And it is this which in general renders sailors so averse to it, and excites a prejudice very unfavourable to the salubrity of distilled seawater. One of the great objects to be ascertained was, whether this disagreeable smell and taste was peculiar to seawater or arose from the act of distillation.

In the month of July, last year, the king ordered some experiments to be made, upon a large scale, at the three ports of Brest, Rochefort, and Toulon. The instructions given were as follows: That a sufficient quantity of seawater should be distilled to prepare, for the space of a month, bread and other food for a certain number of criminals, who were employed on the works of these ports, and also to supply them with drink, keeping from them during that period every other liquid. Ten or twelve persons at each part voluntarily came forward and offered themselves for the experiment.

The persons employed by government first distilled a sufficient quantity of seawater, without the admixture of any other substance. This produce dissolved soap, dressed vegetables, produced the same appearances, with the aerometer, as that distilled from spring water. There was no difference between the one and the other. But the distilled seawater had always that empyreumatic taste and smell, of which we have before spoken; and it was so strong, that the commission at Toulon called it *odeur de marine*, and *odeur de marecage*. But this is not peculiar to seawater, for the result of a distillation of fresh water had always the same taste and smell. Neither of these liquids immediately loses this by being filtered through charcoal; but by being [174] exposed for some time to the air, the distilled seawater loses this unpleasant quality, and then it does not differ from fresh water derived from the purest source; and both have equally stood every chemical test to which they have been exposed. The chemical properties of this water having thus been determined, it remains to give an account of the effects upon the individuals who underwent the experiment. These are the principal results:

Brest. During the first days, those who drank the water complained of a weight upon the stomach. This indisposition, which was the only one they experienced, soon decreased upon taking exercise, and totally went off by an additional ounce of biscuit added to their common ration. One of them, on the 29th day, had a few symptoms, but which he himself attributed to an indigestion, from some bacon he had eaten. Eight individuals drank twenty-five pints a day, rather more than three pints each,—(N. B. The French pint contains very near fifty-seven cubic inches of English measure, and is the regulation size for the claret or Bordeaux bottle; but in general the bottles are rather smaller. The French pint is therefore equal to rather more than nineteen-twentieths of an English quart, wine measure.)

Toulon. The results obtained at the arsenal of this town, were not less decisive or satisfactory. The six persons who made the experiment acquired a greater degree of freshness in their appearance, and were much fatter. Their daily consumption of distilled water was nine pounds (*poids de marc*) for drink, and eleven pounds for cooking. This is nearly the same relative quantity as those at Brest.

Rochefort. The experiments here have not been made with the same regularity; because the fifteen persons fixed upon had all agreed to say that they were very ill. The two principal ones complained of violent cholics and diarrhœas: but the plot was discovered, and upon being put upon the sick-list, (*à la diète*,) they were laughed at by their companions. No one of them was really indisposed; on the contrary, many thought they experienced some good effect in regard to some infirmities under which they had long laboured.

The above are not, however, the only experiments which have been made upon this beverage. [175] Several persons wishing to ascertain its effects by individual experience, have voluntarily confined themselves to its use; and the members of the commission of inquiry are almost in the daily practice of taking it. The captain of the Duclat has taken it every day at his meals for twenty days, and has experienced not the smallest inconvenience from its use. M. M. Vasse, and Chatelain, apothecaries to the marine at Brest, have occasionally kept the water in their mouths for four hours, by constantly renewing it, and have not found either the sharp taste, or other caustic qualities, which have been said to be peculiar to it. And here it may be proper to state, that the mouths of all the individuals who had taken the water for a length of time were examined, without the detection of any thing in them either of a swollen or inflammatory appearance. Such are the reports of commissioners employed to investigate the effects of distilled seawater, who, although separated at a great distance from each other, and having no communication, all agree in the inference, that it may be employed without any injury to the health, both as a beverage and in cookery, for the space of at least a month; and the fair presumption is, that it may be employed for a much longer time; and that in consequence, it must be considered as a very happy resource in long voyages of discovery.

FINE ARTS. [176]

ART. XXI. *Essay on Musical Temperament. By Professor* FISHER, *of Yale College.*

[*Concluded from* page 35.]

PROPOSITION V.

To determine that position of any degree in the scale, which will render all the concords terminated by it, at a medium, the most harmonious; supposing their relative frequency given, and all the other degrees fixed.

The best scheme of temperament for the changeable scale, on supposition that all the concords were of equally frequent occurrence, is investigated in Prop. III. But it is shown, in the last Proposition, that some chords occur in practice far more frequently than others. Hence it becomes necessary to ascertain what changes in the scale above referred to, this different frequency requires. Any given degree, as C, terminates six different concords; a Vth, IIId, and 3d above, and the same intervals below it. Let the numbers denoting the frequency of these chords below C be denoted by *a*, *b*, and *c*, and their temperaments, before the position of C is changed, by *m*, *n*, and *p*: and let the frequency of the chords above C be denoted by *a′*, *b′*, and *c′*, and their temperaments by *m′*, *n′*, and *p′*, respectively. If, now, we regard any two of these 6 chords, whose temperaments would be diminished by moving C opposite ways, and of which the sum of the temperaments is consequently fixed, it is manifest that the more frequent the occurrence, the less ought to be the temperament. Were we guided *only* by the consideration of making the aggregate of dissonance heard in them in a given time, the least possible, we should make the one of most frequent occurrence perfect, and throw the whole of the temperament upon the other. Let, for example, *a* be greater than *a′*, and let *x* be any variable distance to which C is [177] moved, so as to diminish the temperament *m*, of the chord whose frequency is expressed by *a*. Then the temperament of *a* will become = $m \sim x$, and that of $a' = m' + x$. Hence, as the dissonance head in each, in a given time, is in the compound ratio of its frequency of occurrence and its temperament, their aggregate dissonance will be as $a \cdot \overline{m \sim x} + a' \cdot \overline{m' + x}$; a quantity which, as *a* is supposed greater than *a′*, evidently becomes a minimum when $x = m$, or the chord, whose frequency is *a*, is made perfect. But in this way we render the harmony of the chords very unequal, which is, cæteris paribus, a disadvantage. As these considerations are heterogeneous, it must be a matter of judgment, rather than of mathematical certainty, what precise weight is to be given to each. We will give so much weight to the latter consideration, as to make the temperament of each concord *inversely as its frequency*. We have then

$a : a' :: \frac{1}{m - x} : \frac{1}{m' + x}$; which gives $x = \frac{am - a'm'}{a + a'}$.

But there are six concords to be accommodated, instead of two; and it is evident that all the pairs cannot have their temperament inversely as their frequency, since the numbers *a*, *b*, &c. and *m*, *n*, &c. have no constant ratio to each other. This, however, will be the case, at a medium, if *x* be made such, that the *sum* of the products of the numbers expressing the frequency of those chords whose temperaments are increased by *x*, into their respective temperaments, shall be equal to the sum of the corresponding products belonging to those chords whose temperaments are diminished by *x*. Applying this principle to the system of temperament in Prop. III, which flattens all the concords, it is plain that raising any given degree by *x* will increase the temperaments of the concords above that degree, and diminish those of the concords below it. Hence it ought to be raised till $(m - x)\,a + (n - x)b + (p - x)c = (m' + x)a + (n' + x)b' + (p + x)c'$; from which *x* is found = $\frac{am - a'm' + bn - b'n' + cp - c'p'}{a + a' + b + b' + c + c'}$. Should either of the temperaments be sharp, the sign of that term of the numerator, in which it occurs, must be changed; and should [178] the total value of the expression be negative, *x* must be taken below C.

PROPOSITION VI.

To determine that system of temperaments for the concords of the changeable scale, which will render it, including every consideration, the most harmonious possible.

We can scarcely expect to find any direct analytical process, which will furnish us with a solution of this complicated problem, at a single operation. We shall therefore content ourselves with a method which gradually approximates towards the desired results. The best position of any given degree, as C, supposing all the rest fixed, is determined by the last proposition. In the same manner it is evident that the constitution of the whole scale will be the best possible, when no degree in it can be elevated or depressed, without rendering the sums of the products there referred to, unequal. We can approximate to this state of the scale, by applying the theorem in Prop. V. to each of the degrees successively. It is not essential in what order the application is made; but for the sake of uniformity, in the successive approximations, we will begin with that degree which has the greatest sum $a + a' + b +$ &c. belonging to it, and proceed regularly to that in which it is least. Making the equal temperament of Prop. III., (in which the Vths, IIIds, and 3ds are flattened, 154, 77 and 77, respectively.) the standard from which to commence the alterations in the scale required by the unequal frequency of different chords, and beginning with D, the theorem gives $x = 5$. Hence supposing the rest of the degrees in the scale unaltered, it will be in the most harmonious state, when D is raised $^5/_{540}$ of a comma. For by the last proposition, the temperament of the six concords affected by changing the place of D is best distributed, and that of the other concords is not at all affected. We will now proceed to the second degree in the scale, viz. A; in which the application of the theorem gives $x = 13$. In this application, however, as D was before raised 5, *m*, the temperament of the Vth below A, must be taken 154 + 5; and in all the succeeding operations, when the exterior termination of any concord has been already altered, we must take its temperament, not what it was at first, but what it has become, by such previous alteration. In this manner, the scale is becoming more harmonious at every step, till we have completed the whole succession of degrees which it contains. [179]

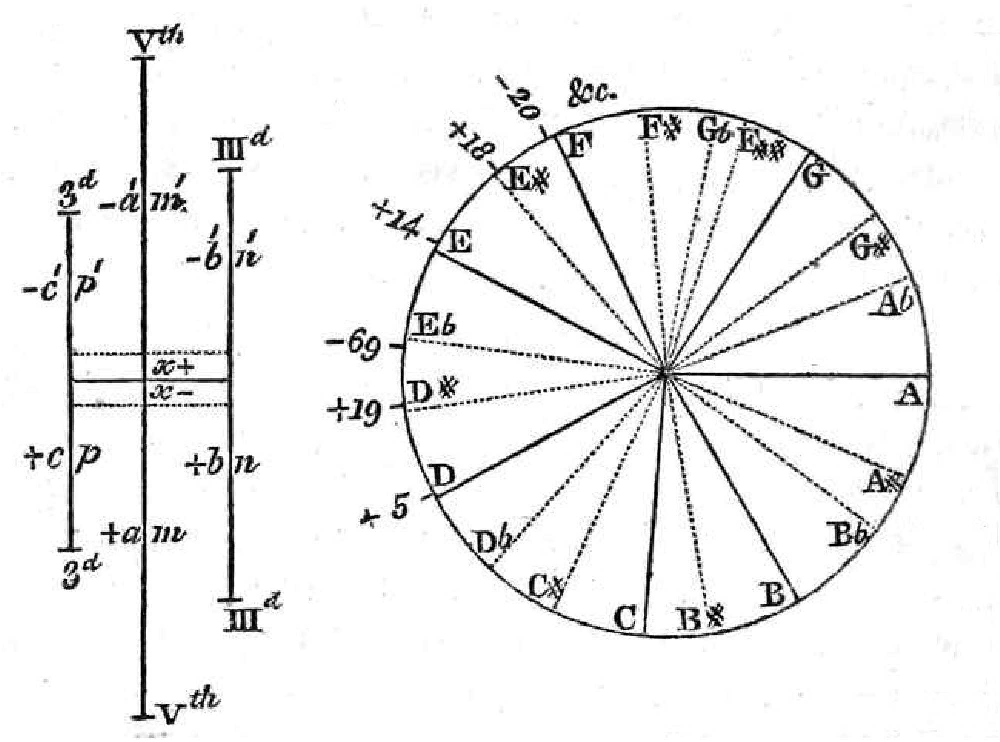
Let us now revert to D, the place where we began. As each of the outer extremities of the chords which are terminated by D has been changed, a new application of the theorem will give a second correction for the place of D; although, as the numbers *a*, *a'*, *b*, &c. continue the same, it will be less than before. Continue the process through the whole scale, and a second approximation to the most harmonious state will be obtained. In this manner let the theorem be applied, till the value of *x* is exhausted, for every degree; and it will then be in the most harmonious state possible. Three operations gave the following results:

TABLE V.

Bases.	1st Operation.	2d.	3d.	Bases.	1st Operation.	2d.	3d.
F※	+18	+5	+1	B※	+18	+5	0
F	-20	-6	-1	B	+19	+5	0
E※	+18	+5	0	B♭	-23	-10	-1
E	+14	+5	0	A※	+18	+7	0
E♭	-69	-8	-1	A	+13	+4	+1
D※	+19	+5	+1	A♭	-71	-7	-2
D	+5	+2	+1	G※	+17	+5	0
D♭	-45	-7	-2	G	-14	0	0
C※	+18	+6	0	F※※	+44	+5	0
C	-5	-5	-2	G♭	-46	-5	0

The sign *plus* denotes that the degree to which it belongs is to be raised, and *minus*, that it is to be depressed. The corrections in each succeeding operation are to be added to those in the preceding. The errors, in the 3d approximation, are so trifling, that a 4th would be wholly useless. [180]

Note. The foregoing calculations will be rendered much more expeditious and sure, by reducing the theorem, in some sense, to a diagram, as in the first of the following figures; and by applying the successive corrections to the circumference of a circle divided into parts proportioned to the intervals of the enharmonic scale, as in the second.



Proposition VII.

To determine the temperaments and beats of all the concords, together with the values of the diatonic and chromatic intervals, and the lengths and vibrations per second of a string producing all the sounds, of the system resulting from the last proposition.

The temperaments of all the concords are easily deduced from Table V. The Vth CG, for example, has its lower extremity lowered 12, and its upper extremity 14. Hence it is flatter by 2 than at first, and consequently its temperament=156. The temperaments of all the concords, thus calculated, will be found in the 2d, 3d, and 4th columns of Table VII. [181]

Having ascertained the temperaments, the value of the diatonic and chromatic intervals may be found. The Vth CG being flattened 156, and the Vth FC 139, the major tone FG must be diminished 156 + 139, or be = 4820. By thus fixing the extent of one interval after another, from the temperaments of either of the different kinds of concords, as is most convenient, the intervals in question will be found to have the values exhibited in Table VI.

Let the numbers in this table be added successively, beginning at the bottom, to the log. of 240, the number of vibrations per second of the tenor C, (see Rees's Cyc. Art. Concert Pitch,) and the numbers corresponding to these logarithms will be the vibrations in a second, of a string sounding the several degrees of the scale. They are shown in col. 6, Table VII.

Since the length of a string cæteris paribus is inversely as its number of vibrations, the lengths in col. 5 may be deduced from the vibrations in col. 6; or more expeditiously, by subtracting the numerical distances from C of the several degrees in Table VI. from O, and taking the corresponding numbers, from the table of logarithms. These numbers, when used as logarithms, must be brought back to the decimal form, agreeably to Scholium 2. Prop. I.

To find the number of beats made in a second by any concord, it is only necessary to take from col. 5 the numbers belonging to the degrees which terminate that concord, and to multiply them crosswise into the terms of its perfect ratio. The difference of the products will be the number of beats made in a second. The 3 last columns contain the beats made by each of the concords, in 10 seconds.

[182]

TABLE VI.

C	———	———	———	C
	2998	2998	———	B♯
			1772	
B	———	———	———	B
	1831		3033	
B♭	———	4813		
			———	A♯
	2982		1780	
A	———	———	———	A
	1871		3030	
A♭	———	4839		
			———	G♯
	2968		1809	
G	———	———	———	G
	1814		———	F♯♯
G♭	———		1798	
		4820	———	F♯
	3006		1824	
F	———	———	———	F
			———	E♯
	2988	2988		
			1777	
E	———	———	———	E
	1870		3028	
E♭	———			
		4818	———	D♯
	2948		1790	
D	———	———	———	D
	1835		3018	
D♭	———	4827		
			———	C♯
	2992		1809	
C	———	———	———	C

TABLE VII.

Bases	Temperaments of the Vths♭	IIIds♭	3ds♭	Lengths of String.	Vibrations in a Second.	Beats in 10 S. of the Vths.	IIIds.	3ds.
B※			77	51431	466,64			43,4
B	154	76	93	53574	447,98	47,4	39,0	57,8
B♭	147	35	97	55880	429,49	43,5	17,7	57,4
A※	156		78	57448	417,77	45,1		46,2
A	153	71	107	59852	400,99	42,5	33,5	59,4
A♭	154	9		62487	384,08	40,4	4,0	
G※	151	76	75	64177	373,97	39,1	32,9	39,2
G	132	39	97	66907	358,71	32,9	16,3	48,1
F※※			101	68778	348,95			48,5
G♭		56		69760	344,03		21,9	
F※	154	76	83	71685	334,80	36,0	29,2	38,5
F	139	32	130	74760	321,03	30,9	11,9	57,8
E※	154		78	76874	312,20	33,2		33,5
E	149	74	110	80085	299,68	30,8	25,2	45,3
E♭	110	13	54	83608	287,05	21,7	4,1	21,5
D※	154	53	78	85868	279,50	29,6	17,0	30,0
D	144	61	112	89480	268,21	26,5	18,5	41,1
D♭	180	50		93342	257,12	32,0	14,8	
C※	156	78	82	95920	250,20	26,6	22,0	28,0
C	156	46	143	100000	240,00	25,8	12,8	47,5

[184]

Proposition VIII.

To compare the harmoniousness of the foregoing system with that of several others, which have been most known and approved.

The aggregate of dissonance, heard in any tempered concord, is as its temperament (Prop. I.) when its frequency of occurrence is given, and as its frequency of occurrence, when its temperament is given: hence, universally, it is as the product of both. The whole amount of dissonance heard in all the concords of the same name must consequently be as the sum of the products of the numbers denoting their temperaments, each into the number in Table IV. denoting its frequency. These products, for the scale of Huygens which divides the octave into 31 equal parts, of which the tone is 5 and the semi-tone 3; for the system of mean tones, and for Dr. Smith's system of equal harmony, compared with the scale of the last proposition, (cutting off the three right-hand figures) stand as follows:

TABLE VIII.

Systems.		Huygen's.	Dr. Smith's.	Mean Tones.	New Scale.
Disso-	{ Vths	825	945	850	786
nance	{ IIIds	121	382	0	240
of the	{ 3ds	1049	629	944	683
Total		1995	1956	1794	1709

Were we to adhere to Dr. Smith's measure of equal harmony, the rows of products belonging to the Vths, IIIds, and 3ds, must be divided, respectively, by $\frac{1}{3}$, $^{1}/_{10}$, and $^{1}/_{13}$ (the reciprocals of half the products of the terms of their perfect ratios,) before they could be properly added to express the whole amount of dissonance heard in all the concords; but, according to Prop. I. the simple products ought to be added, and the sums at the bottom of the table will express the true ratio of [185]
the aggregate dissonance of the systems under which they stand. The last has decidedly the advantage over the first, both in regard to the aggregate dissonance, and the equality of its distribution among the different classes of concords. It has nearly an equal advantage over the second in regard to the first of these considerations; although in regard to the equality of distribution, the latter has slightly the advantage. It has, in a small degree, the advantage over the third, in regard to the aggregate dissonance; while, as it respects the equality of its distribution, it has the decided preference. It is true that the temperaments of the concords of the same name, in the new scale, are not as in the others, absolutely equal; but no one of them is so large as to give any offence to the nicest ear. The largest in the whole scale exceeds the uniform temperament of Dr. Smith's Vths by only $^{1}/_{18}$ of a comma.

Scholium 1.

The above system may be put in practice on the organ, by making the successive Vths CG, GD, DE, &c. beat flat at the rate contained in Table VII., descending an octave, where necessary, and doubling the number of beats belonging to any degree in the table, when the Vth to be tuned has its base in the octave above the treble C. The tenor C must first be made to vibrate 240 in a second, the methods of doing which are detailed at length in various authors. Whenever a IIId results from the Vths tuned, its beats ought to be compared with those required in the table, and the correctness of the Vths thus proved. This system is as easy, in practice, as any other; for no one can be tuned correctly except by counting the beats, and rendering them conformable to what that system requires. The intervals of the first octave tuned ought to be adjusted with the utmost accuracy, by a table of beats. When this is done, the labour of making perfect the other octaves of the same stop, and the unisons, octaves, Vths, &c. of the other stops, is the same in every system. This last, indeed, is so much the most laborious part of the tuning of the organ, that if even much more labour were required than actually is, in adjusting the intervals of the [186]
octave first tuned it would occasion little difference in the whole.

Scholium 2.

The harmony of the IIIds and 3ds in any of the foregoing systems for the changeable scale is so much finer than it can possibly be in the common Douzeave, that it seems highly desirable that this scale should be introduced into general use. But the increased bulk and expense attendant on the introduction of so many new pipes or strings, together with the trouble occasioned to the performer, in rectifying the scale for music in the different keys, have hitherto prevented its becoming generally adopted. To multiply the number of finger keys would render execution on the instrument extremely difficult; and the apparatus necessary for transferring the action of the same key from one string or set of pipes to another, besides being complicated and expensive, requires such exactness that it must be continually liable to get out of order. This latter expedient, however, has been deemed the only practicable one, and has been carried into effect, under different forms, by Dr. Smith, Mr. Hawkes, M. Loeschman, and others. But Dr. Smith's plan (which is confined to stringed instruments) requires only one of the unisons to be used at once; while those of the two latter nearly double the whole number of strings or pipes. It deserves an experiment, among the makers of imperfect instruments, whether a changeable scale cannot be rendered practicable, at least on the piano forte,[26] without increasing the number of strings, and at the same time allowing both the unisons to be used together—either by [187]
an apparatus for slightly increasing the tension of the strings, or by one which shall intercept the vibrations of such a part of the string, at its extremity, as shall elevate its tone, by the diesis of the system of temperament adopted. Were only 4 degrees to the octave, furnishing the instrument with 5 sharps and 4 flats, thus rendered changeable, there is little music which could not be correctly executed upon it.

Scholium 3.

In the same general manner, may be found the best system of intervals, for a scale confined to a less number of degrees than that of the complete Enharmonic scale. In such an investigation, the numbers in Table IV. expressing the frequency of all such adjacent degrees as have but one sound in the given scale, must be united; and the temperaments *m*, *n*, &c. of the theorem, when belonging to concords whose terminating degrees are united to those adjacent, must be taken, not what they were in the complete scale, but what they become, considering them as terminated by the substituted adjacent degree.

If, for example, the best temperaments were required for a scale of 15 degrees to the octave, such as is that of some European organs, or in other words, having no Enharmonic intervals except D♯ E♭, and G♯ A♭,—the numbers in Table IV. belonging to C♯ and D♭, E♯ and F, F♯ and G ♭, &c. must be united, and their sums substituted when they occur, for *a*, *a′*, *b*, &c. in the theorem; while the temperament, for example, of the IIId on C♯ must not be reckoned 77 as in the complete scale, but 1261 – 77 sharp, since its upper termination has become F, instead of E♯. With these variations let the same theorem be applied as before, till no value of *x* can be obtained, and the temperaments for that scale will be the best adjusted possible. [188]

But as the scale which contains but 13 degrees, or 12 intervals, to the octave, is in much more general use than every other, we shall content ourselves with stating *how* the problem may be solved for scales containing any intermediate number of degrees, and proceed directly to the consideration of that which is so much the most practically important.

Lemma.

No arrangement of the intervals in the common scale of 12 degrees, which renders none of the Vths or 3ds sharp, and none of the IIIds flat, can make any change in the aggregate temperaments of all the concords of the same name.

We will conceive the 12 Vths of the Douzeave scale to be arranged in succession, as CG, GD, DA, &c. embracing 7 octaves. Let them at first be all equal: they will each be flattened 49. I say that no change in these Vths which preserves the two extreme octaves perfect, and renders none of them sharp, can alter the sum of their temperaments. Let *a*, *b*, *c*, &c. be any quantities, positive or negative, by which the points C, G, D, &c. may be conceived to be raised above the corresponding points, belonging to the scheme of equal Vths. Then as the mean temperament Vth = V – 49, the first Vth in the supposed arrangement will be V – 49 + *a*. The distance from C to D will be, in like manner, 2 · (V – 49) + *b*; and consequently the Vth GD will be V – 49 + *b* – *a*. In the same manner the third Vth DE will be V – 49 + *c* – *b*, &c. Hence the temperament of CG = -49 + *a*, of GD = -49 + *b* – *a*, of DA = -49 + *c* – *b*, &c. Adding the 12 temperaments together, we find their sum = -12 × 49 + *a* + *b* + &c. – *a* – *b* – &c. in which all the terms except the first destroy each other, and leave their sum = –12 × 49 which is the aggregate temperament of the twelve equal Vths in the scheme of equal semitones.

The same reasoning holds good if we bring these Vths within the compass of an octave; since, if the octave be kept perfect, all the Vths on the same letter, in whatever octave they are situated, must have the same temperament. [189]

The reasoning is precisely the same for the IIIds and 3ds, considering the former as forming 4 distinct series of an octave each, beginning with C, C♯, D and E♭; and the latter as forming 3 distinct series of an octave each, beginning with C, C♯ and D. If the former be made all equal, each will be sharpened 343; if the latter be made equal, each will be flattened 392. In every system which renders none of the former flat, and none of the latter sharp, the sum of their temperaments will be 12 × 343, and 12 × 392, respectively.

Cor. The demonstration holds equally true, whatever be the magnitude of *a*, *b*, *c*, &c.: only if they be such that the difference –*a* + *b*, –*b* + *c*, &c. of any two successive ones be greater than the temperament of the corresponding concord in the system of equal semitones, the temperament of that chord must be reckoned negative, and the *sum*, in the enunciation of the proposition, must be considered as the excess of those temperaments which have the same sign with those of the same concords in the system of equal semitones, above those which have the contrary sign. Hence it is universally true that the excess of the flat above the sharp temperaments of the Vths is equal to 12 × 49; that the excess of the sharp above the flat temperaments of the IIIds is equal to 12 × 343; and that the excess of the flat above the sharp temperaments of the 3ds is 12 × 392. Hence likewise we have a very easy method of *proving* whether the temperaments of any given system have been correctly calculated. It is only to add those which have the same sign; and if the differences of the sums be equal to the products just stated, the work is right.

Proposition IX.

If all the concords of the same name, in a scale of twelve intervals to the octave, were of equally frequent occurrence, the best system of temperament would be that of equal semitones.

It is evidently best, so far as the concords of the same name are concerned, that if of equal frequency, they should be equally tempered, unless by rendering them unequal, their medium temperament could be diminished; but this appears, from the Lemma, to be impossible. By tempering them unequally, the aggregate dissonance heard in a given time, by supposition of their equal frequency, would not be diminished, whilst the disadvantage of a transition from a better to a worse harmony would be incurred. Some advocates of irregular systems of temperament have, indeed, maintained this irregularity to be a positive advantage, as giving variety of character to the different keys. But this variety of character is obviously neither more nor less than that of greater and less degrees of dissonance. Now, what performer on a perfect instrument ever struck his intervals false, for the sake of variety? Who was ever gratified by the variety produced in vocal music by a voice slightly out of tune? If this be absurd, when applied to instruments capable of perfect harmony, it is scarcely less so to urge variety of character as being of itself a sufficient ground for introducing large temperaments into the scale. For these large temperaments will have nearly the same effect, compared with the smaller ones, that small [190] temperaments would have, when compared with the perfect harmony of voices and perfect instruments. Possibly a discordant interval, or a concord largely tempered, might, in a few instances, add to the resources of the composer. But when an instrument is once tuned, the situation of these intervals is fixed beyond his control, and by occurring in a passage where his design required the most perfect harmony, it might as often thwart as favour the intended effect.

Since, then, the proposition is true in reference to the Vths, IIIds, and 3ds, when separately considered, it will be equally true when they are considered jointly, that is, as formed into harmonic triads, unless, by rendering the concords of the same name unequal in their temperament, the mean temperament of the Vths could be increased, and that of the IIIds and 3ds proportionally diminished. Could this be done, it might be a question whether the more equal distribution of the temperament among the concords of different names, might not justify the introduction of some inequality among those of the same name. But it is demonstrated in the [191] Lemma, that the sum of the temperaments of each parcel of concords, in the system of equal semitones, is the least possible. Hence no changes in the Vths can diminish the average temperaments of the IIIds and 3ds.

Cor. Hence we derive an important practical conclusion: that whatever irregularities are introduced into the scale, must be such as are demanded by the different frequency of occurrence of the several concords. If we make any alterations in the scale of equal semitones, this must be our sole criterion. A given system of temperament is eligible, in proportion to the accuracy with which it is deduced from the different frequency of the different concords. And those who maintain that the frequency of different intervals does not sensibly vary, or that it is of such a nature as not to be susceptible of calculation, must, to be consistent, adhere to the scale of equal semitones.

Proposition X.

To determine the best distribution of the temperaments of the concords in the Douzeave Scale.

As the scale of equal semitones has been demonstrated to be the best, on supposition that all the concords of the same name occurred equally often, it ought to be made the standard from which all the variations, required by their unequal frequency, are to be reckoned. To find a set of numbers expressing the relative frequency of the several concords in the common scale, we have only to unite the numbers in Table IV. standing against those adjacent degrees which have but one sound in this scale. They will then stand as in the following table:

[192]

TABLE IX.

Bases.	Vths, 4ths, and Octaves.	IIIds, 6ths, and Octaves.	3ds, VIths, and Octaves.
B	221	135	1161
B♭	418	654	34
A	870	568	1085
G♯	57	82	365⅕
G	1207	1197	567¼
F♯	67	29½	1072
F	639	924	78
E	548	323	1151
E♭	265⅓	363½	144½
D	1166	943	569
C♯	26	18	581
C	816	1131	184

The general theorem of Prop. V. is equally applicable to the determination of the approximate place for any degree in this scale, considering the numbers in the above table as those to be substituted for *a*, *a*′, *b*, &c.; and *m*, *n*, and *p*, in the first instance, as 49, –343 and 392, the uniform temperaments of the Vths, IIIds, and 3ds, in the scale of equal semitones. Since, however, the temperaments of the IIIds in this scale are sharp, which would require the signs of the 3d and 4th terms in the numerator of the general formula to be continually changed, it will be rendered more convenient for practice, if they are changed at first, so that it will stand thus:

$$x = \frac{am - a'm' - bn + b'n' + cp - c'p'}{a + a' + b + b' + c + c'} .$$

Three successive applications of this theorem to each degree in the scale, in the manner described Prop. VI., will bring them very near to the required position, as appears by the smallness of the corrections in the 3d column below, where the results of the several operations are exhibited at one view. [193]

TABLE X.

Bases.	First Operation.	Second Operation.	Third Operation.
B	-140	-35	-2
B♭	+308	+33	-1
A	-8	-23	+2
G♯	-257	-22	-2
G	+107	+24	-8
F♯	-264	-7	0
F	+238	+40	+6
E	-80	-34	-4
E♭	+157	+2	-4
D	+58	+ 8	0
C♯	-352	-29	-1
C	+176	+29	+4

Cor. Hence we may deduce, in the same manner as in Prop. VII., the diatonic and chromatic intervals, the lengths of a string and their vibrations in a second, and the temperaments and beats of all the concords for the scale which results from the foregoing computations. They may be seen in the two following tables:

[194]

TABLE XI.

DIATONIC AND CHROMATIC INTERVALS.

C	———	———	C
	2895	2895	
B	———	———	B
		1991	
	4869	———	B♭
		2878	
A	———	———	A
		2761	
	4865	———	G♯
		2104	
G	———	———	G
		2903	
	4856	———	F♯
		1953	
F	———	———	F
	2911	2911	
E	———	———	E
		2235	
	4833	———	E♭
		2598	
D	———	———	D
		2957	
	4874	———	C♯
		1917	
C	———	———	C

TABLE XII.

Bases.	Temperaments of the			Lengths of Strings.	Vibrations per Second.	Beats in 10 Seconds of the		
	Vths♭	IIIds♯	3ds♭			Vths	IIIds	3ds
B	143	675	149	53446	449,04	44,0	352,8	92,4
B♭	105	69	1114	55954	428,92	30,8	34,0	155,2♯
A	138	10.♭	154	59787	401,42	38,6	4,6♭	85,2
G♯	387♯	833	288	63712	376,79	98,7♯	360,5	155,4
G	106	43	175	66874	358,88	26,4	17,6	86,8
F♯	160	954	150	71496	335,68	37,2	372,8	69,8
F	124	30	957	74786	320,92	27,6	10,8	143,0♯
E	108	180	151	79970	300,10	22,2	66,6	62,0
E♭	136♯	311	818	84194	285,06	26,6♯	102,2	186,6♯
D	144	6	174	89384	268,50	26,6	2,2	64,0
C♯	52♯	1009	128	95682	250,83	10,9♯	295,3	44,8
C	135	16	446	100000	240,00	22,4	4,0	147,0

Nothing in the above tables will need explanation, except the anomalous sharp beats of the 3ds, in the last column. These are derived from the perfect ratio 6 : 7, because these 3ds are, in reality, much nearer to the ratio of 6 : 7 than to that of 5 : 6; and hence could their beats be counted, they would be those of the table, and not those which would be derived from considering these 3ds as having flat temperaments of the ratio 5 : 6. But although the beats are slower, the nearer they approach the ratio 6 : 7, this ought not to be regarded as any sufficient reason for admitting so large temperaments into the scale, were it not absolutely necessary, in order to accommodate those 3ds which are of far more frequent occurrence. [196] Although the beats of these 3ds grow slower as their temperaments are increased, yet they are losing their character in melody; and become, in this respect, more and more offensive, the more they are tempered. Hence the harmony and melody of the several intervals, jointly considered, are to be judged of rather from their temperaments, in the three first columns, than from their beats, in the three last.

Scholium 1.

It will be perceived, from a comparison of the temperaments in Table XII. with the corresponding numbers in Table IX., that the harshness of the several concords, especially of the IIIds and 3ds, is, in general, nearly in the inverse ratio of their frequency. The contending claims of the different concords render it impossible that this ratio should hold exactly. Including the Vths, the harmony of the concords is much more nearly *equal,* than the principle of rendering the temperament of each inversely as its frequency, could it be carried into complete effect, would require.

Scholium 2.

The foregoing system may be put in practice, on the organ, by making the Vths beat flat, with the exception of those on C♯, E♭, and G♯, which must beat sharp, at the rate required in the table; proving the correctness of the temperaments of the Vths, by comparing the beats of the IIIds, as they rise, with those required by column two. Should less accuracy be required, the IIIds on C, D, and A, might be made perfect, without producing any essential change in the system. This would reduce the labour of counting the beats to eight degrees only.

Scholium 3.

To show that the computations of the different frequency of occurrence of the different concords, on which this system of temperament is founded, may be relied on as practically correct, for music in general, it may be proper to state, that a similar series of calculations had [197] been before made, from an enumeration of the concords in fifty scores of music entirely different from that made use of in Prop. IV. They were not, indeed, made with the same accuracy, for the music of which the chords were counted, was too generally of the simpler kind, and the numbers corresponding to those in the two columns under each concord in Table II., and those belonging to the major and to the minor signatures, corresponding to the numbers in Table III., were added, before the products were taken, instead of keeping the modes distinct, which is necessary to perfect accuracy. Yet the resulting scheme of temperament was essentially the same throughout, with the one which has been just described. It had the same anomalous temperaments, viz. the Vths on C♯, E♭, and G♯; and the IIId on A; and these anomalies were similar in degree. The greatest difference between any two corresponding temperaments, was between those of the 3d on E♭; the first computation making it only 702, while the last has it 818.

Proposition XI.

The aggregate of dissonance, heard in a given time, in the system of temperament unfolded in the last Proposition, will be less than in either of the systems generally practised.

In order to compare the foregoing system with those which have been most generally approved, the temperaments of all the concords have been calculated, in the system of equal semitones; in that of Earl Stanhope, which has had considerable celebrity; in that of Dr. T. Young; in that of Mr. Hawkes; in that of Kirnberger, which has been extensively adopted in Germany; and in that which is described by Rousseau and D'Alembert as generally practised in France. If these temperaments be multiplied into the corresponding numbers of Table IX., agreeably to what was shown under Prop. VIII., and those products which belong to the several concords of the same name be added, the sums, after the three right-hand figures are cut off, will be as follows:

[198]

TABLE XIII.

Systems.		Mean Temp.	Young's.	Kirnberger's.	French.	Stanhope's.	Hawkes'.	New Scale.
Disso-	{ Vths	309	494	681	561	595	665	810
nance	{ IIIds	2184	1541	1397	1346	1175	925	530
of the	{ 3ds	2740	2448	2019	2121	1992	1676	1363
Total		5233	4483	4097	4028	3762	3266	2703

From an inspection of the sums at the foot of the table, it will be seen that the amount of dissonance heard in a given time is decidedly less in the new scale than in either of the others; and that it is scarcely more than half as great as in the scale of equal semitones. On the other hand, the temperament is very unequally distributed, which must be admitted, cæteris paribus, to be a disadvantage. It is even somewhat greater than in the scheme of Mr. Hawkes, although by no means in the same ratio, as the aggregate dissonance is less. It contains one Vth, which will be somewhat harsh, and four IIIds and three 3ds, which will be quite harsh. But these, as will appear from an inspection of Table IX., are, of all others, of by far the most unfrequent occurrence; so that the unpleasant effect of a transition from a better to a much worse harmony will be very seldom felt. In the six simplest keys of the major, and in the three of most frequent occurrence in the minor mode, they are *never* heard, except in occasional modulations; and even then, generally no one, and rarely more than one is heard. Now these nine keys, as will appear from Table III., comprise more than five times as much of the music examined as all the rest. The same remarks might be extended to three other minor keys, were it not that the sharp seventh is so generally used, that it deserves to be considered as an essential note of the key.

But there are two important considerations, more than counterbalancing the objection to this system, derived from the greater inequality in the distribution of its temperaments, which have [199] not been hitherto noticed, as not being susceptible of mathematical computation.

1st. We have gone on the supposition that tunes on the more difficult keys are as often performed, according to their number, as those on the simpler keys; and have taken for the measure of dissonance, in different systems, what would be actually heard, if the 1600 scores, whose signatures were examined, were all played in succession, and on the keys to which they are set. But the fact is, that those pieces which are set to the simpler keys are oftener played, and with fuller harmony, on account of the greater ease of execution, than those in which many of the short finger keys must be used.

2d. Pieces on the more difficult keys are often played on the adjacent easier keys, but the contrary is seldom or never done.

Giving to these two considerations no more than a reasonable weight, they will counterbalance the objection, and will render it evident that the sums under the several systems in the table may be taken as a true exhibition of their respective merits, without any injustice to the more equal systems at the left-hand of the table.

Cor. We may hence draw a comparison between the systems in common use. Their merits, when every consideration is taken into view, are nearly in the inverse ratio of the sums denoting their aggregate dissonance. That of Mr. Hawkes is the best, and, in many respects, has a remarkable analogy to the one derived from the preceding investigations.

Cor. 2. As the aggregate dissonance of the changeable scale is calculated on the same principles, in Prop. VIII., as that of the Douzeave in this, a comparison of the results in Table VIII. with those in Table XIII., will furnish us with the relative dissonance of different systems for these different scales. The relative dissonance of the two systems which form the object of this essay, is nearly as 17 : 27. Hence it appears, that by inserting eight new sounds between those of the common octave, the harshness of the music executed, at a medium of all the keys, may be diminished by more than one third of the whole, while the transition from a better to a worse harmony will never be perceived.

Art. XXII. *Notice of Colonel Trumbull's Picture of the Declaration of Independence.* [200]

It is proper that some mention of this great national work should be made, in publications less transient than newspapers; and as the fine arts are included within the design of this Journal, it may with propriety be noticed here. This is the greatest work which the art of painting has ever produced in the United States. The picture is magnificent both in size and in execution. The dimensions of the canvass are eighteen feet by twelve.

"This picture forms one of a series long since meditated by Mr. Trumbull, in which it was intended to represent the most important events, civil and military, of the American revolution, with portraits of the most distinguished actors in the various scenes. The materials for this purpose were collected many years ago, and two plates have been engraved from paintings of the deaths of Gen. Warren and Gen. Montgomery;[27] but the work was suspended, in consequence of the political convulsions, which, during twenty-five years, were so fatal to the arts of peace.

"The government of the United States have ordered four of the subjects originally proposed by

Mr. Trumbull, to be painted by him, and to be deposited in the capitol.

"No event in human history ever shed a more salutary influence over the destinies of so great a mass of mankind: the wisdom of no political act was ever so soon and so powerfully demonstrated, by such magnificent consequences. And justly may the nation be proud of the act itself; and of those eminent men, its authors, whose patriotism (rising above enthusiasm, and the passions which have so often bewildered mankind) was calm, dignified, persevering, and always under the guidance of reason and virtue.

"The painting represents the congress at the moment when the committee advance to the table of the president to make their report. [201]

"It contains faithful portraits of all those members who were living when the picture was begun, and of all others of whom any authentic representation could be obtained. Of a small number, no trace could be discovered; and nothing was admitted which was not authentic."

This picture is now, by permission of government, exhibited in the Academy of Arts in New-York, and will probably be shown in some of our other principal cities, before it receives its final location at Washington.

It exhibits the interior of the then Congress Hall at Philadelphia. Most of the members are represented as sitting in their respective chairs, or, in various instances, as standing in different parts of the room. Almost all the portraits were taken by Colonel Trumbull *from the living men*, and their accuracy may therefore be relied on.

The president, John Hancock, sitting at a table, and elevated somewhat by a low platform, is receiving the report of the committee declaring the independence of the colonies; that committee, individually illustrious, and in this august transaction collectively memorable, was composed of Franklin, Adams, Sherman, Jefferson, and Livingston. Mr. Jefferson, in the prime of life, is in the act of laying upon the table the great charter of a nation's liberties; while his companions support him by their silent but dignified presence, and the venerable Franklin, in particular, imposes new obligations on his country's gratitude.

The figures are as large as the life; and it may safely be said, that the world never beheld, on a similar occasion, a more noble assemblage. It was the native and unchartered nobility of great talent, cultivated intelligence, superior manners, high moral aim, and devoted patriotism. The crisis demanded the utmost firmness of which the human mind is capable—a firmness not produced, for the moment, by passion and enthusiasm, but resting on the most able comprehension of both duties and dangers, and on a *principled* determination to combat the one [202]
and to fulfil the other.

This moral effect has been produced in the fullest and finest manner by this great painter; and no true American can contemplate this picture without gratitude to the men who, under God, asserted his liberties, and to the artist who has commemorated the event, and transmitted the very features and persons of the actors to posterity. Such efforts of the pencil tend powerfully also to invigorate patriotism, and to prompt the rising generation to emulate such glorious examples.

The composition and execution in this picture are in a masterly style. The grouping of so many full length portraits, in a scene in which there could scarcely be any action, and in such a manner as to dispose of them without monotony, was an attainment of no small difficulty. The painter could not even avail himself of the adventitious relief of splendid costume and furniture, and of magnificence or rich decorations in architecture; for on this occasion both were characterized by an elegant simplicity only, such however as became the actors and the crisis.

The composition has all the variety of which it is susceptible; and there is also enough of it in the style of dress and of features to relieve the eye from any danger of satiety.

It is believed, that in this picture, the United States possess a treasure to which there is no parallel in the world. In no instance, within our knowledge, is there an exhibition to an equal extent, of the actual portraits of an illustrious assembly, concerned in so momentous a transaction.

It was a great thing to assert, *in principle*, the liberties of this country; but it was also a great thing to vindicate them by arms; and we rejoice that Colonel Trumbull is still to proceed, under the sanction of government, to delineate other scenes, in which Washington and his illustrious American coadjutors, and the flower of French chivalry, were the actors. In the maturity of his experience, skill, and fame—possessed, as he is, of the portraits of most of the great men of that period, taken principally from the life, and having been himself largely and personally conversant [203]
with them in their great deeds, we trust that the government will promptly second what we doubt not the united voice of the nation will demand—that the illustrious artist should dedicate the evening of his life to his country's honour and glory.

INTELLIGENCE.

Art. XXIII. *An Address to the People of the Western Country.*

A number of the citizens of Cincinnati have recently instituted a society for the collection, preservation, exhibition, and illustration of natural and artificial curiosities, particularly those of the *western country*. The first efforts of the managers will be directed to the establishment of a permanent museum, on a scale so comprehensive as to receive specimens of every thing curious which they may be able to procure. In attempting to form this repository, they must of course solicit the aid of their fellow-citizens in all quarters of the extensive region, whose ancient works and natural history they propose to illustrate. The following are the classes of objects that will especially attract their attention, and to which they are desirous, at an early period, of directing the views of the community:

1. Our metals and minerals generally, including petrifactions.
2. Our indigenous animals, embracing the remains of those which are now extinct.
3. The relics of the unknown people who constructed the ancient works of the western country.
4. The various articles manufactured, for ornament or use, by the present savage tribes.

The subjects of the first class are considered by the Society as extremely interesting. Every citizen of the western country must *feel* the necessity of a speedy developement of its mineral [204]
resources. To find beneath our own soil an adequate supply of the various minerals which are now imported at an enormous expense, must be regarded by all as a matter of the first and greatest importance. The managers are anxious to be instrumental in the advancement of this useful work, and earnestly solicit the co-operation of the public. They will be thankful for specimens of all the rare or curious minerals that may be discovered in this country. To every specimen that may be transmitted, a label should be attached, stating either the kind of rock or stratum to which it belonged, or its precise locality. Whenever it is required, the managers will have a part of any specimen which is sent to them, analyzed, and a correct report made of its nature, thus affording to the discoverer a full opportunity of availing himself of all the pecuniary advantages that may attend the discovery.

As objects of scientific interest, the managers intend, as early as possible, to commence the formation of a cabinet of petrifactions. The rocks of few other countries contain a greater number and variety of these animal remains of the ancient ocean, than the limestone districts of the Ohio and Mississippi. They both astonish and confound most of the travellers through this region; and although objects of familiar examination to ourselves, they have not been collected or described by our citizens. An extensive and well arranged cabinet of these extraneous fossils would afford, both to the zoologist and geologist, an exquisite feast. It is hoped that every specimen sent to the Society will be accompanied by a label, stating the place where it was found.

It is the wish of the Society to obtain and preserve specimens of all the native animals of this country. Most of the larger quadrupeds having receded before the unceasing extension of our settlements, are now so rare as to be unknown to all but our oldest emigrants. Measures will be taken by the managers to procure from the general retreat in the northwest, and exhibit to the people in the Ohio countries, a specimen of every quadruped which lately inhabited them; and while engaged in this enterprise, they hope to import from the same distant wilderness, a variety [205]
of the animals which are peculiar to it.

Our native birds have not retreated, like our quadrupeds, and are, therefore, within our reach. The managers hope to see the Society, in due time, in possession of a large collection of these beautiful animals. In the accomplishment of this undertaking, it is easy to perceive that the Society may be powerfully aided by the community: and a sanguine hope is entertained, that no backwardness or indifference will be manifested by those who may fortunately have it in their power to forward specimens.

In collecting the fishes and reptiles of the Ohio, the Mississippi, and the Lakes, the managers will likewise need all the aid which their fellow-citizens may feel disposed to give them. Although not a very interesting department of zoology, no object of the Society offers so great a prospect of novelty as that which embraces these animals. The managers, therefore, flatter themselves that they will not be suffered to proceed unaided in this portion of their labours.

The obscure and neglected race of insects will not be overlooked, and any specimens sufficiently perfect to be introduced into a cabinet of entomology, will be thankfully received.

The western country, from having afforded some of the most gigantic and curious remains of land animals which have yet been discovered, seems entitled to a museum of such relics. A collection of this kind will be one of the earliest objects of the Society. Its funds will be liberally expended for the purpose; and if aided by those who may be so fortunate as to discover any of the great bones which lie buried in our alluvial or bottom lands, the managers hope, at no distant period, to repair, in some degree, the losses which have been repeatedly sustained by exportation of these interesting fossils.

The third class comprises objects of very little utility, but of extraordinary interest. Nothing, indeed, presented by the western country seems to excite in a higher degree the curiosity of strangers, than the relics and vestiges of the extinct and comparatively civilized population with which it abounds.

The managers will make every possible effort to form an extensive collection of these remains.

It is extremely unfortunate for those engaged in researches concerning the objects of this class, that so many of them have been disseminated abroad. To study them successfully, it is necessary that they should be compared, and for this purpose they must be brought together. The managers hope, therefore, that such persons as now hold, or may hereafter possess any of these antiquities, will dispose of them to the Society, instead of sending them out of the country. In this way, and in this only, can a valuable collection of these unique curiosities be formed. [206]

The remaining class comprehends the weapons, utensils, trinkets, and other manufactures of our neighbouring Indians, of which the managers hope, in a short time, to be able to exhibit a great variety.

The curiosities of this country are the primary, but not the exclusive objects of the Society. It proposes in due time to open a gallery of paintings, and thus offer to the lovers and cultivators of the fine arts, a few of those models which are absolutely necessary to the gratification and improvement of their taste.

The managers will be happy, moreover, to receive from such of their eastern brethren as are desirous of contributing to the amelioration and advancement of a new and remote community, any of the productions of foreign countries that may be calculated to promote this object; and will, in return, cheerfully exchange any specimens of the curiosities of this country which they can spare without injury to their collection.

They will, if required, pay a reasonable price for every article which may be deemed worthy of introduction into the museum. They intend to publish, annually, a catalogue of all the more valuable donations which may be made to the museum, with the names of the donors.

Elijah Slack,
James Findlay,
William Steele, } *Managers*.
Jesse Embree,
Daniel Drake,

Cincinnati, Sept. 15, 1818.

Caleb Atwater, Esq. of Circleville, Ohio, is engaged in writing Notes on the State of Ohio, a work which is intended to embrace the most important features and interests of this new and rising State. [207]

To this laudable effort, and to that of the Western Museum Society, whose address is published above, we cordially wish success. From the zeal, talent, and industry of the gentlemen concerned, we have every reason to expect a happy result.

We view, with much satisfaction, the efforts which have been already made, and are rapidly increasing, to bring to light the resources, and to develope the history, of the western States; and it will always give us pleasure, if through the medium of this Journal, or in any other manner, we can contribute to promote them.

Art. XXIV. *Extract of a Letter from Colonel Gibbs to the Editor.*

Sunswick, June, 1818.

Dear Sir,

Since I saw you, I have made only one experiment on magnetism. I determined the power of my magnet, as it had been shut up in the dark for a long time, and lying down. I then exposed it to the rays of the sun, also lying down, and remote from the iron support, and I found that it had gained 12 oz. power in 40 minutes, and 14 oz. power only in five hours.

Art. XXV. *A New Lamp, without Flame.*

From the Annals of Philosophy for March, 1818. Communicated by Mr. Thomas Gill.

This lamp is one of the results of the new discoveries in chemistry. It has been found, by Sir H. Davy, that a fine platina wire, heated red hot, and held in the vapour of ether, would continue [208] ignited for some time; but, I believe, no practical use has been made of this fact.

If a cylindrical coil of thin platina wire be placed, part of it round the cotton wick of a spirit lamp, and part of it above the wick, and the lamp be lighted, so as to heat the wire to redness; on the flame being blown out, the vapour of the alcohol will keep the upper part of the wire *red hot*, for any length of time, according to the supply of alcohol, and with little expenditure thereof; so as to be in constant readiness to kindle German fungus, or paper prepared with nitre, and, by this means, to light a sulphur match at pleasure. This lamp affords sufficient light to show the hour of the night by a watch, and to perform many other useful services; but does not hinder the repose of persons unaccustomed to keep a light burning in their bed-room, nor does it require to be snuffed.

The proper size of the platina wire is the $^{1}/_{100}$th part of an inch: a larger one will only yield a dull, red light, and a smaller one is difficult to use. About 12 turns of the wire will be sufficient, coiled around any cylindrical body suited to the size of the wick of the lamp; and four or five coils should be placed on the wick, and the remainder of the wire above it; and which will be the part ignited. A wick, composed of twelve threads of the ordinary sized lamp cotton yarn, with the platina wire coiled around it, will require about half an ounce of alcohol to keep it alight for eight hours.

An agreeable and slightly acid smell arises from this lamp during its ignition. It is perfectly safe, as nothing can fall from it; and its novel appearance, in a wick's keeping red hot for such a length of time, is very surprising to persons unacquainted with its nature.

P.S.—When the wire has become oxided, it will be necessary to uncoil it, and rub it bright again with fine glass-paper; which will cause it to act again with increased effect.

REMARK.

Such wire as is here described may, probably, be obtained in Philadelphia.

FOOTNOTES:

[17] In using the word "pit," instead of "mine," I have accommodated my language to the custom of the country.

[18] Since the above article was written we have received some as large as a finger.

[19] The green earth of most mineralogists. Editor.

[20] *Formation*—a geological phrase, of German origin.

[21] Doubtless the pea ore of the Wernerians. Editor.

[22] This jet of cold water being let into the cylinder itself, necessarily cooled it at every stroke; and then it was necessary to heat it again to the boiling point, before the piston would reascend, and thus a vast loss of heat occurred. Editor.

[23] But it is not necessary (as in the plate) to crowd the engine into the after-part of the boat, the boilers maybe placed forward, and near them, or over them, *the cylinder*, &c. The power is then communicated to the stern-wheel by a long shaft, supported on, or immediately under, the deck. This arrangement gives room for loading both behind and before the boilers and engine, and equalizes the burden. This is the actual arrangement of the Merrimack boat.

[24] It is found with very high steam that the source of supply must be above the *chamber*, or a small quantity of cold water introduced to condense the steam therein.

[25] Taken from the Philosophical Magazine, and by that work from the Annales de Chimie and de Physique, for January, 1818.

[26] A method of rendering changeable the sound of the same pipes in the organ, which had occurred to the writer, but which was not inserted above on account of the supposed difficulty of making the change sufficient in degree, he has since found to have been executed by the Rev. H. Liston, who has succeeded, by means of shaders capable of being brought before the mouths of his pipes by the action of pedals, in giving them three distinct sounds each, varying by two commas. (See the description of his Enharmonic organ, in Rees' Cyc. or Tilloch's Phil. Mag.) His scale embraces 59 intervals to the octave, and is intended to produce perfect harmony in all the keys. But as it will require the use of pedals perpetually, even on the same key, and a ready and perfect knowledge of small musical intervals, which practical musicians can seldom possess, there is no probability that it will ever be extensively adopted. Perhaps, however, four or five sounds, such as D※, E※, A♭, D♭, might be added to the common scale of 12 intervals by means of his mechanism, with advantage. An instrument thus furnished would require the use of pedals but seldom, and would contain chromatic degrees sufficient for the accurate performance of the great mass of organ music.

[27] These picture, as is well known, represent the assault on Quebec, and the battle of Bunker's Hill.

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GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

Art. I. *Hints on some of the Outlines of Geological Arrangement, with particular Reference to the System of Werner, in a letter to the Editor, from* William Maclure, *Esq. dated Paris, 22d August, 1818*.

INTRODUCTORY REMARKS.

Some years since, during Mr. Maclure's geological survey of the United States, the editor had the pleasure of passing a few days, in company with that gentleman, in exploring the geology of the vicinity of New-Haven. Near that town, junctions, on an extensive scale, between widely different formations, are to be observed. A radius of ten miles, with New-Haven for a centre, will describe a circle within which the geological student may find (with the exception of formations, unquestionably volcanic) most of the important rocks of the globe, and a radius of even six or seven miles will include the greater number of these. At, and near the terminations of the primitive ranges, there are rocks which appear to have, in a high degree, the characters of the transition class. Among them is the beautiful green marble of the Milford Hills, seven miles from New-Haven. Mr. Maclure visited that district, and even suggested the first hint which afterward [210] led to the discovery of the marble. Doubts being entertained concerning some of the geological relations of those rocks, a letter was addressed to Mr. Maclure (then in Philadelphia) on the subject. His answer is subjoined.

In giving it to the public, the editor takes a liberty which he hopes the respectable author will pardon, because his production, although evidently never intended for the public eye, contains statements and opinions of no small importance to the young geologist, especially of this country.

Geology, at the present day, means not a merely theoretical and usually a visionary and baseless speculation, concerning the origin of the globe; but, on the contrary, the *result of actual examination into the nature, structure, and arrangement of the materials of which it is composed*. It is therefore obvious, that the opinions of those men, who, with competent talent and science, have, with a direct reference to this subject, explored many countries, and visited different continents, are entitled to pre-eminent respect. Saussure, by his scientific journeys among the Alps, (although a limited district) has given deserved celebrity to his own name, and, if it were possible, has thrown an additional charm of attraction over those romantic and sublime regions. Dolomieu has made us familiar with the productions and phenomena of volcanoes, those awful and mysterious laboratories of subterranean fire. Humboldt has surveyed the sublimest peaks of both continents, and examined the structure of the globe amidst the valleys of Mexico and the snows of Chimborazo and Pinchinca; and Werner, with opportunities much more limited, (confined indeed to his native country, Saxony) but with astonishing sagacity and perseverance, deduced from what he saw, a classification of the rocks of our globe, which, although not perfect, has done immense service to the science of Geology. In this distinguished group (to which other important names might be added) Mr. Maclure has unquestionably a right to be placed. Few men have seen so much of the structure of our globe, and few have done so much with such small pretensions. His work on American Geology is noticed with becoming respect even in Edinburgh, [211] [28] that focus of geological science. His opinions on some of the more obscure and doubtful parts of the Wernerian geology are worthy of peculiar consideration; for they are founded on a course of observations vastly more extensive than Werner ever had it in his power to make. The name of Werner will always be venerated as long as geological science shall be cultivated, for geology owes more to him than to any other man; but his pupils should not now demand that implicit and unqualified adoption of ALL his opinions, which will allow no other question to be raised, than what Werner taught or believed.

With these explanatory remarks, the following extract of Mr. Maclure's letter is now subjoined:

DEAR SIR,

Your letter of the 26th June came just as I was embarking for Europe. The information it requires concerning the primitive trap and flint slate, the transition and secondary rocks, &c. &c. is difficult to give without the aid of specimens, and frequently requires the examination of the relative position of the strata before any correct idea can be formed. I will, however, endeavour to give you the little my experience has brought me acquainted with.

Following the nomenclature of Werner, I have given a list of his rocks; but in describing them there are many of his names which I do not use; because I never met with them. Primitive trap is one instance—I do not use trap as a substantive, except in describing that kind of trap which Werner calls the newest flætz trap, the nearest to which is your trap,[29] which covers the oldest red sandstone.

The primitive flint slate is in the same predicament. I have always found it on the borders of the transition, between it and the secondary.

Primitive gypsum I have not found.

What Werner calls primitive trap may perhaps be compact hornblende, or perhaps the newest [212] flætz trap, when it happens to cover the primitive; for, this species of trap, like the currents of lava, covers indiscriminately all classes of rocks, and is one reason why I consider it as the remains of ancient lava.

Transition trap is a rock that I have not met with, and may perhaps be a part of the flætz trap that happened to cover the transition, without any immediate connexion, but like a current of lava, overlying all the classes of rocks it meets with. This misapplication of names naturally arises from the system of neptunian origin, on which the nomenclature of Werner is founded.

Greywake and greywake slate are aggregates of rounded particles of rocks, evidently the detritus of more ancient formations, and differ from the aggregates of pudding and sandstone of the secondary class, in the following properties, viz.

The aggregates of transition are harder and much more compact, than the secondary; they are also cemented by argil, taking a slaty form.

This cement is in much greater quantity, in proportion to the particles cemented, and has the appearance as if the cement at the time of formation, had a consistence sufficient to prevent the particles from touching each other.

They have, in common with all the transition rocks, a regular and uniform dip from the horizon, from 10 to 40 degrees; and sometimes more. This is perhaps the strongest mark of distinction which separates them from the secondary, which are horizontal, or follow the inequalities of the surface on which they were deposited.

The transition are distinguished from the primitive in being aggregates of rounded particles, having little or no crystallization, and containing, or alternating with strata, which contain organic matter.

The oldest red sandstone, with all its accompanying strata, I should incline to put into the transition, as having many of the properties of that class, and occupying the same relative situation in the stratification of the globe. It is at a constant dip (although small) from the [213] horizon; the cement is in greater quantities in proportion to the particles cemented than in any of the secondary aggregates, &c. &c.

The character of the secondary is a horizontal position, that perhaps does not admit of the same facility of examining the relative situation of its stratification. The compact limestone is, probably, with reason, considered as the lowest of the secondary formation, and always under the coal formation, but it appears to me that the secondary is deposited in basins alongside of one another, and that each basin has a different order of superposition, according to the nature of the agents employed in the deposition; that it is a partial, and by no means a general deposition. The secondary aggregates of sandstone and puddings have been evidently beds of sand or gravel, and of course, in that state would be called alluvial, but when cemented together by the infiltration of water, carrying along with it lime, iron, or any other body capable of agglutinating the particles together, become rocks, and may alternate in all proportions.

I am therefore inclined to think, that in geology the best mode for the greatest part of the secondary would be to give the relative position of the strata of each valley or basin; and I am rather of opinion that they would all differ from one another.

The French and English basin having chalk for the lowest stratum, which has occupied the geologists of both countries for these 10 or 15 years, is perhaps the best known; yet they do not know the relative position of the chalk and coals, because coals have not been found in the same basin with chalk: coals occupy basins filled with different kinds of rocks, and have no resemblance to the rocks found covering the chalk.

Art. II. *On the Geology, Mineralogy, Scenery, and Curiosities of Parts of Virginia, Tennessee,* [214] *and the Alabama and Mississippi Territories, &c. with Miscellaneous Remarks, in a letter to the Editor.* By the Rev. Elias Cornelius.

To Benjamin Silliman, Professor, &c.

SIR,

Having recently returned from a tour of considerable extent in the United States, I avail myself with pleasure of the first leisure moment, to communicate, agreeably to your request, some facts, relative to the Mineralogy and Geology of that part of the country through which I passed.

INTRODUCTORY REMARKS.

Before doing this, you will permit me to premise, that in consequence of my limited acquaintance with these branches of Natural Science, and the still more limited time, which other and important concerns allowed me to devote to the subject, I can do little more than give a general description. What my eye could catch, as I travelled from one country and wilderness to another, preserving occasionally a few of the most interesting specimens, was all I could do. The specimens you have received. The narrative I am about to give, is drawn principally from the notes which were taken on the journey, and will be confined to a simple *statement of such facts* as were either observed by myself, or derived from good authority. Their application to preconceived theories, I leave to those who have more leisure and disposition for speculation than myself.

A description of a few natural and artificial curiosities which came under particular notice, will not, I trust, be thought an improper digression. The whole is committed to your disposal; and if it shall add but one mite to the treasury of American Natural History, I shall be gratified, and [215] rejoice to have made even this small remuneration for your unwearied efforts, to impart to one, formerly your pupil, a love for Natural Science.

The Author's Route.

My route was in a line nearly direct from Boston to New-Orleans; passing through the principal cities to Washington; thence, diagonally, through Virginia, East Tennessee, and the northwestern angle of Georgia; in a western course through the north division of the Territory of Alabama, to the northeastern boundary of the State of Mississippi; and thence in a line nearly southwest to Natchez. From this last place I descended the river Mississippi to New-Orleans. On my return I frequently varied from this course, and had increased opportunities for surveying the country. In both instances I passed through the countries belonging to the Cherokee, Chickesaw, and Choctaw tribes of Indians, and travelled among them, in all, about one thousand miles.

Geology of Virginia.

As others have described more minutely and accurately than I can, the country north of Virginia, I shall begin with a few remarks on the geological character of that State. It is there that the traveller, in passing from the Atlantic to the interior, crosses successively the most important formations of the earth, from the most recent alluvial to the oldest primitive. For a considerable distance from the coast, the country is alluvial. It then assumes an older secondary formation[30]—and sandstone and puddingstone are frequent. This is the character of the District of Columbia, and indeed of a great part of the valley of the Potomac.

Sandstone of the Capitol, &c.

In this valley, and adjacent to the river, is found the *sandstone* of which the President's house, and the Capitol are constructed. It is composed of fine silicious grains, is easily wrought, and [216] from its colour, has the appearance at a small distance of white marble.

Beautiful Breccia.

It is also in the valley of this river, and not far from its famous passage through the Blue Ridge, that immense quarries of beautiful Breccia have been opened. This rock was first brought into use by Mr. Latrobe, for some years employed by the government as principal architect. It is composed of pebbles, and fragments of silicious and calcareous stones of almost every size, from a grain, to several inches in diameter, strongly and perfectly cemented. Some are angular, others rounded. Their colours are very various, and often bright. Red, white, brown, gray, and green, are alternately conspicuous, with every intermediate shade. Owing to the silicious stones which are frequently imbedded through the mass, it is wrought with much difficulty; but when finished, shows a fine polish, and is unquestionably one of the most beautifully variegated marbles, that ever ornamented any place. It would be difficult to conceive of any thing more grand than the hall of the Representatives, in the Capitol, supported as it is by twenty or thirty pillars formed of the solid rock, and placed in an amphitheatrical range; each pillar about three feet in diameter, and twenty in height. Some idea of the labour which is employed in working the marble may be formed from the fact, that the expense of each pillar is estimated at five thousand dollars. The specimens in your possession, are good examples of its general structure, but convey no adequate idea of its beauty.

Petrifaction of Wood.

It will be proper to notice in this place, a petrifaction of wood which is found on the road from Washington to Fredericksburgh, 16 miles from the latter, and four miles north of the court-house in Stafford county. It is remarkable for its size, rather than for any singularity in the composition. It was found by digging away the earth on the side of the road, and appears to have been the [217] trunk of a considerable tree. It is firmly fixed in the ground, and penetrates it obliquely; how far has not yet been ascertained. At the time I saw it about two feet had been exposed. The diameter is about eight inches. Its colour is white, sometimes resembling that of wood. The fibres are well preserved, and so is the general structure. It is much to be desired, that some one would clear it from its bed, and give it entire to one of our mineralogical cabinets.

Geological Features.

Next to the alluvial and secondary formations, as you pass to the west and northwest, are to be found ranges of granite and shistose, and other primitive rocks; interspersed with these may be seen sandstone, clay, slate, quartz, and limestone. Granite ranges were particularly seen in the neighbourhood of Fredericksburgh, crossing the Rappahannock; and in Orange and Albemarle counties, extending nearly to the Blue Ridge. Great quantities of quartz and quartz rock, sometimes covering with their fragments the sides of hills, are frequent. Another, and more interesting rock in the same connexion, is found in Albemarle county. For some time I doubted to what class to refer it. But from its resemblance to the rocks of the east and west mountains near New-Haven, I ventured to call it trap or whinstone. It becomes more abundant as you approach the Blue Ridge, and the granite disappears. On the sides and summit of the mountain, its appearance is more decidedly that of greenstone. In crossing the southwest mountain, the range to which Monticello belongs, and distant from the Blue Ridge about 25 miles, I observed the same rock. Whether this opinion is just, you will be able to decide from the specimens which have been forwarded.

Blue Ridge.

I have repeatedly named the Blue Ridge. It is the first of those long and parallel ranges of mountains, called the Alleghany; and constitutes one of the most prominent features in the [218] geology of the United States. Its height I cannot determine with accuracy. Probably it would not average more than one thousand feet. Its base may extend in diameter from one to two miles; and yet such is the influence it has on the climate, that vegetation on the eastern, is usually two weeks earlier than on the western side. And what is remarkable, this difference obtains, on the former side at least, until you arrive within a few hundred yards of the summit. I crossed the mountain in two places, distant from each other one hundred miles, but observed nothing essentially different in their mineralogy. At one of them called the *Rockfish-Gap*, on the road from Charlotteville to Staunton, I spent a few hours, and brought away specimens of all the varieties of minerals which I could find. These have been submitted to your inspection. Among them, you will, I think, see greenstone, epidote, and slate more or less allied to the first. These are the most common rocks, and excepting the second, are usually stratified. The epidote is generally associated with quartz, and sometimes is imbedded in it. In some instances it has a porphyritic appearance, and is very beautiful. In others, it is coated with small filaments of a greenish asbestos. Other minerals were found, whose nature I could not so easily determine. I regret exceedingly, that I cannot furnish you with a more complete description of this interesting mountain. That its character is peculiar, or different from the country on either side of it, must be obvious to the most superficial observer. Its principal rock does indeed bear a resemblance to the trap or whinstone of Albemarle county, and yet I think you will say it is not the same. One fact of importance cannot be mistaken; this mountain constitutes the great dividing line between the granite and limestone countries. For you no sooner reach its western base, than the greenstone and epidote disappear; and *limestone* pervades the country for hundreds of miles in every direction. In all the distance from this mountain to New-Orleans, I did not find a single specimen of granite, or greenstone. This may appear singular, since Mr. Maclure and Professor Cleaveland have a granite range on their maps, immediately west of the Blue Ridge; and even that mountain [219] is on those maps, in some parts of it, covered with the granitic tinge. This may be true. I can answer for only two points of it, and for that part of the country beyond, lying near the main road to Tennessee. In this route I descended almost the whole length of the great valley included between the Blue Ridge on the east, and the north mountain on the west. But in no instance did I meet with specimens of granite; nor west of the Blue Ridge with any prevailing rock but limestone. I know of no reason why the Blue Ridge should not be regarded as the first great dividing line between the granite and limestone countries. The change in the geological formation is so sudden and striking, that it would be difficult for the most careless traveller with his eyes open, not to observe it. The face of nature, he cannot but perceive, wears a different aspect; the air is more cool and lively; even the water which he drinks possesses new properties perceptible to his taste. The inhabitants no longer speak of their "sandstone water;" but every where he hears of "limestone water." Indeed for 800 miles in the direction which I travelled, he tastes no other water. Every spring and every rivulet, is strongly impregnated with carbonate of lime. The vessels in which it is prepared for culinary use, soon become lined with a white calcareous crust. Nor is its taste the only inconvenience experienced by the traveller unaccustomed to it. It often injures the health of a stranger, and covers the surface of the body with cutaneous eruptions.

Limestone country in inclined Strata.

The geological observer has now entered upon a very interesting field. Its great extent, and its wonderful uniformity, give new facilities to investigation. Two divisions of it seem to have been made in nature.

The *first* is that which includes the limestone lying in INCLINED STRATA. This division extends from the Blue Ridge, to the Cumberland mountain in East Tennessee, a distance in the direction of my route of 500 miles. Of course it includes all the ranges, five in number, of the Alleghany mountains. The strata lie in a course northeast and southwest, the same as the general course of [220] the mountains. The angle which they make with the horizon is very variable, from 25° to 45°. The colour of the rock varies from blue, and pale blue, to gray, or grayish white, frequently it presents a dull earthy appearance. The fracture is more or less conchoidal. Sometimes the rock assumes a different character, and the fracture is *uneven*, and the texture firm. This last is distinguished from the former, not only by the fracture, but by the colour. It is usually spoken of by the inhabitants as the *gray limestone*, the colour of the other being usually of a bluish cast. It differs from that also by being less brittle, and possessing the quality denominated by stonecutters, "*tough*." In consequence of this, and its enduring heat better, it is more frequently used in building than the other. This variety of limestone is not uncommon. Its colour is not always *gray*, sometimes it is a reddish brown, and sometimes white. Immense quantities of it, possessing either a grayish or reddish brown colour, are found in the vicinity of Knoxville, East Tennessee. One range of it is crossed by every road, passing to the south and east of Knoxville. Its appearance is that of some variegated marbles; white veins penetrate it, and wind through it in every direction. Whether any part of it has a texture sufficiently fine and firm to be wrought to advantage, is yet to be determined. To the eye of a superficial observer, there are many indications that it has. A specimen of very fine white marble, resembling the Italian white, was shown me in Augusta county, Virginia, which was found 15 miles from Staunton, where there is said to be a considerable quantity of it.

Limestone country in Horizontal Strata.

The *second* great division of the limestone country extends, on the route which I took, two hundred miles from the Cumberland mountain, and others associated with it southwest, as far as the Dividing Ridge, which separates the waters flowing into the Tennessee from those which proceed direct to the gulf of Mexico. The grand circumstance which distinguishes the limestone [221] of this division from that already described, is this, ITS STRATA ARE HORIZONTAL. Frequently immense piles may be seen forming bold precipices, but *always* in horizontal layers, differing in thickness, from a few inches to many feet. How far this arrangement extends to the west and north, I have not yet been able to learn. Travellers always speak of the limestone rocks in West Tennessee and Kentucky as *flat*, from which circumstance I conclude that the Cumberland mountain forms for a considerable distance at least, the eastern boundary. I have observed but three other particulars in which the strata of the *horizontal* differ from those of the *inclined* limestone.

1. Its colour is not so strongly marked with the bluish tinge.

2. It is not so commonly penetrated with white veins of a semicrystallized carbonate of lime; nor is it so frequently associated with the *uneven* fractured species.

3. Petrifactions are oftener found in it.

I will here take the liberty to suggest, whether in our maps of geology, some notice should not be taken of this very important division in the limestone country. Such a division exists *in fact*; nature has made it; and if geology depends on nature for its only legitimate inductions, there can be no reason why a feature so prominent as this, should be overlooked. I shall not undertake to account for their difference: but would not every geological theorist consider them as distinct formations?[31]

Cumberland Mountain.

The Cumberland mountain, which forms a part of this dividing line, is itself a singular formation. It belongs to the class called "Table mountains." Its width varies from a few miles, to [222] more than fifty. Its height is not perceptibly different from that of the Blue Ridge. It forms a circuit, in a shape somewhat resembling a half moon. Winding to the southwest, it keeps a course north of the Tennessee river, in some places nearly parallel with it; passes a few miles to the southeast of Huntsville in the Alabama Territory, and not long after terminates. At one part, over which I crossed, the mountain is eighteen miles wide. This is about 150 miles southwest of Knoxville, a little north of the 35th degree of N. Lat. I had not ascended the mountain more than halfway, before I found sandstone begin to intermingle with limestone strata. As I drew near the summit, the limestone disappeared entirely, and sandstone prevailed in abundance, with no other mineral associated until I reached the western descent, where I met bold precipices of horizontal limestone, reaching from the base to the summit. I examined several sandstone rocks while crossing the mountain, found them usually imbedded in the earth, generally with flat surfaces, of a fine grain, and strong texture. The colour is usually a reddish brown, or grayish red. The specimen which you have received is a good example. I crossed this mountain in the vicinity of Huntsville, not less than one hundred miles southwest of the place above-mentioned, and found it not wider than mountains commonly are. Its height had also become less, and horizontal limestone in regular strata prevailed in every part.

Although this mountain forms a part of the dividing line which has been mentioned, it does not exclusively so: for the Rackoon mountain, which crosses the Tennessee river, at the place so well known by the name of "the Suck," and the Look-Out mountain, which terminates abruptly about 6 miles to the left of "the Suck," form an acute angle with the Cumberland, and are composed of horizontal strata of limestone. Thus it would appear the line which divides the two kingdoms of this rock, is nearly north and south, inclining perhaps a few points to the east and west.

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Scenery.

And here I cannot forbear pausing a moment to call your attention to the grand and picturesque scenery which opens to the view of the admiring spectator. The country is still possessed by the aborigines, and the hand of civilization has done but little to soften the wild aspect of nature. The Tennessee River, having concentrated into one mass, the numerous streams it has received in its course of three or four hundred miles, glides through an extended valley with a rapid and overwhelming current, half a mile in width. At this place, a group of mountains stand ready to dispute its progress. First, the "Look-Out," an independent range, commencing thirty miles below, presents, opposite the River's course, its bold and rocky termination of two thousand feet. Around its brow is a pallisade of naked rocks, from seventy to one hundred feet. The River flows upon its base, and instantly twines to the right. Passing on for six miles further it turns again, and is met by the side of the Rackoon mountain. Collecting its strength into a channel of seventy yards, it severs the mountain, and rushes tumultuously through the rocky defile, wafting the trembling navigator at the rate of a mile in two or three minutes. This passage is called "The Suck." The summit of the Look-Out mountain overlooks the whole country. And to those who can be delighted with the view of an interminable forest, penetrated by the windings of a bold river, interspersed with hundreds of verdant prairies, and broken by many ridges and mountains, furnishes in the month of May, a landscape, which yields to few others in extent, variety or beauty. Even the aborigines have not been insensible to its charms; for in the name which they have given to the Look-Out mountain we have a laconic, but very striking description of the scenery. This name in the Cherokee language, without the aspirated sounds, is "O-tullēē-ton-tannâ-tâ-kunnâ-ēē;" literally, "mountains looking at each other."

I have already remarked that the limestone of this mountain lies in horizontal strata: one mile east from its base it is inclined. Like the Cumberland, it contains immense rocks of sandstone, [224] but of a coarser grain, verging occasionally into pudding stone. I was told by a white man, a professed millwright, that among these sandstone rocks, he knew of many which were suitable for millstones. At the missionary establishment, called "Brainerd," eight miles east of the mountain, I saw one of them which was used for this purpose to much advantage. It is composed of fine and large grains of silicious stones, nearly white, and resembling pebbles of white quartz: the texture is firm.

Silicious Minerals, &c.

I will now notice an important fact, applicable to the whole extent of limestone country, which has come under my observation. It is its association with a description of minerals, all of which appear to be *silicious*. To describe them minutely, would require several pages. From the time I entered the limestone country till I left it this association was observed. The minerals included in it differ much in their external character. Their size varies from that of rocks to the smallest fragments. Usually they lie loose upon the earth, in angular forms, having the appearance of a stone that has been broken in pieces by the hammer. Sometimes they cover the sides of hills and mountains in such abundance as to prevent or impede vegetation. When the disintegration is minute, they are serviceable rather than otherwise; and the farmer talks of his "good black," or "white gravel land." It renders this service, I presume, not by decomposition, but by preventing the soil and its manure from being washed away. Indeed the different varieties of it are generally scattered over the surface, in pieces so small, that for convenience sake, the whole may be denominated a *silicious gravel*.

Sometimes the mineral is imbedded in limestone, in the form of nodules, thus indicating their original connexion with it.

The varieties, so far as I have observed, are quartz, hornstone, flint, jasper, and semi-opal; and [225] several, which to me are non-descripts. *Quartz* is the most abundant. It is found of different colours; compact, and porous or cellular; of every size; simple and associated with other silicious stones; massive and crystallized. In Augusta and Rockbridge counties in Virginia, beautiful crystals of quartz, of a singular form, are found. They are six-sided prisms, with double acuminations, that is, with six-sided pyramids, mounted on the opposite ends of the prism. A specimen of two such crystals united, you have received. It was found near Lexington. A curious variety of the quartz gravel-stone occurs on both sides of Elk River, a few miles above its junction with the Tennessee, in the Alabama territory. As you travel to the west from Huntsville, it appears first in the neighbourhood of Fort Hampton, two miles east of Elk River, and may be seen for ten miles west of that river. The mineral is remarkable for containing a curious petrifaction. Its first appearance is that of a solid screw. On examination, however, you find it is not spiral; but consists of parallel concentric layers. Their diameter varies in different specimens, from that of a pin to half an inch. They stand in the centre of a hollow cylinder, extending its whole length, and occupying about one-third of its dimensions. The stone is sometimes perfectly filled with these forms. The petrifaction I could not have named, had you not pronounced it the "Entrochite."

Hornstone, next to quartz, is the most abundant of the silicious minerals associated with limestone. It is very often seen imbedded in rounded masses, both in the inclined and horizontal strata.

Flint is more rare. Several fine specimens were observed on the western declivity of the Look-Out Mountain, but in no instances in large masses or quantities.

Semi-Opal was found in one instance on the dividing ridge, which constitutes the southwestern boundary of the limestone strata.

Of the non-descripts you have several specimens. One variety strikes fire with steel, is a milk-white colour, adheres slightly to the tongue, and has no degree of translucency on its edges. As [226] Mr. Kain has furnished you with an interesting detail of particular minerals found in East Tennessee and Western Virginia, I need not recapitulate what he has so well said.

(*To be continued.*)

Art. III. *Notice of the Scenery, Geology, Mineralogy, Botany, &c. of Belmont County, Ohio, by* Caleb Atwater, *Esq. of Circleville.*

Belmont county is bounded on the north by Jefferson and Harrison, on the west by Guernsey, and south by Monroe county, and on the east by the Ohio river. It is 27 miles in length, and 21 in breadth, containing 535 square miles. Its name, *Belmont*, or beautiful mountain, indicates its situation, for it contains within its boundaries a fine body of land, rising gradually as you are travelling from the Ohio to the west, until you arrive at about the middle of it, where, from the elevation on which you stand, the eye in an eastern direction, beholds one of the most charming prospects in the state. Looking towards the east, in a pleasant morning, you behold a beautiful country of hill and dale spread out before you, divided into convenient and well-cultivated farms, intersected by glittering streams, meandering through them towards the Ohio. You hear the lowing of numerous herds around you, the shrill matin of the songsters of the forest, and the busy hum of the industrious husbandman; you see here and there a clump of trees interspersed among the cultivated parts of the country; you see the comfortable dwelling-house, the substantial barn, and hear the rumbling noise of the mill; and when you reflect that those who dwell here are industrious and enterprising, virtuous, free, and happy, you behold with pleasure, and listen with delight, while reflecting on the objects around you.

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Geology and Mineralogy.

On the surface is seen a rich vegetable mould, made by the decay and putrefaction of vegetable substances. Along the Ohio, a wide intervale of the richest alluvion is found, which produces as luxuriant a growth of vegetation as any in the world. On the banks of the creeks which pass through this country the alluvial soil is not so wide as that on the river, but equally rich and productive. On the hills (and there are many of them) there are two kinds of soil, the silicious and the argillaceous, the first is formed from the decomposition of the rocks which once covered the surface, the latter from the slate which lay under them. Where these rocks are decomposed, and the country is hilly, it will readily be believed that the two kinds of soil are frequently blended together. In some places we see the best of clay for bricks; whilst in other places, and those in the vicinity of the former, we find the best of sand to mould them in when manufactured. Hard limestone of the very best quality is found in detached fragments in the sides of hills, and in strata, in abundance, along the beds of streams.

The ruins of the sandstone formation are here seen scattered about in fragments, or decomposed and intimately blended with those of other formations.

Fossil coal is every where found under the hills, of the very best quality, and in sufficient quantity not only for the fuel of the present, but many future generations, and is so easily obtained that the expense of fuel is a mere trifle. The oxide of iron, or iron ore variously combined, is recognized in many places, and water combined with muriate of soda, or common salt, is as common. Salines or licks are found in many places, where animals also, both wild and domesticated, resort in great numbers to drink the waters. These are frequently near some little water-course. Several sulphur and chalybeate springs are known to exist in this county, and some which throw out considerable quantities of petroleum.

In a country where iron and fossil coal exist, it is no wonder that copperas should be found. There are places where copperas exudes in a state sufficiently pure in quality, and in quantities [228] sufficient for several families, who collect and use it in dying. The same may be said of alum, which is collected in the same way for similar purposes.

Botany.

Though this county is very rich in the mineral, yet it is not less so in the vegetable kingdom, as may be seen by a reference to the subjoined catalogue, although numbers of trees, shrubs, and plants, are purposely omitted, which are known to exist here.

Family.	*Species.*	*Classical name.*	*Remarks.*
Oak,	White,	Quercus Alba,	Abundant.
————	Black,	——— Nigra,	Do.
————	Meadow,	——— Aquatica,	Along the streams.
————	Chesnut,	——— Prunus,	Scarce.
Maple,	Sugar,	Acer Saccharinum,	Abundant.
————	White,	——— Alba.	
Poplar or Tulip,	White,	Liriodendron,	Abundant.
————	Yellow.		
Walnut,	Black,	Juglans Nigra.	
————	White,	——— Alba.	
————	Shellbark Hickory,	——— Albaovata.	
————	Pignut,	——— Minima.	
————	Bitternut, and probably several other species.		
Beach,	Two species,	Fagus.	
————	Chesnut,	——— Americana.	
Ash,	White,	Fraxinus Alba.	
————	Blue,	——— Purpurea.	
————	Black,	——— Nigra.	
————	Swamp,	——— Aquatica.	
Elm,	Two or three species,	Ulmus.	
Buckeye,	Common,	Æsculusflava Lutea?	
————	Sweet,	——— Maxima?	
Locust,	Four species,	Robinia Pseud Acacia, &c.	
Persimmon,		Diospyros Virginica.	
Linn or Bass Wood,		Tilia Europea.	
Cucumber,		Cucuminis Sylvestris.	[229]
Dog Wood, or American Box,	Two species.		
Sycamore,	Two species,	Platanus Occidentalis, &c.	
Plum,	Several species.		
Thorn,	do. do.		

The red bud; the pawpaw; grape-vines of several species, and growing to a great size; sassafras; the black willow, confined to the streams; the box elder, the common elder, of two species; the sumach, of two species; several species of gooseberries; and a great many others too numerous to be mentioned here. Among the herbaceous plants we must not omit the ginseng, the Virginia snakeroot, the columbo, and the puccoon, two or three thousand pounds of the roots of which are annually carried by the inhabitants to our Atlantic cities. Among the trees, those belonging to the oak family are the most numerous, if not the most valuable. Split into rails, the farmer builds fences with them, and sawed into plank, boards, and scantling, they furnish materials for houses and barns. The sugar maple is sufficiently abundant, so that brown sugar enough is manufactured for domestic purposes. The sycamore is the largest tree along the river, and the poplar is the largest on the hills. The latter grows by the side of the maple and the beach, and is a most valuable wood for the house-builder and the cabinetmaker. This tree is frequently four and five feet in diameter, and continues of nearly the same size as it ascends, 40, 50, and sometimes even 60 feet.

Streams.

The Ohio is the eastern boundary of this county, forming wide intervales along its banks. Indian Wheeling is a fine mill stream rising in Harrison county, and after crossing this, empties into the Ohio, opposite the town of Wheeling, which stands on the Virginia side.

Captina is another excellent mill stream, which after running about 17 or 18 miles in this [230]
county, puts into the Ohio 23 miles by water below Wheeling. These streams visit and fertilize a considerable part of Belmont.

From the view we have taken of this county, its geology, mineralogy, and botany, the reader will probably be prepared with us to conclude, that no part of the union, of equal extent, contains within it greater natural resources, or can support a more dense population.

The seat of justice is St. Clairsville, situated ten miles from the Ohio river, at Wheeling. It contains three houses for public worship, 15 stores, a printing-office, a bank, and 700 inhabitants.

Many of the inhabitants of this county are Quakers or Friends, who are charitable, humane, frugal, enterprising, industrious, and strongly opposed to slavery. From such a population, possessing such advantages, what may we not hope and expect from their exertions? Their fertile valleys will be turned into meadows, and their hills into pastures; the ox will fatten in the former, whilst the flocks of Andalusia will whiten the latter.

Art. IV. *Remarks on the Structure of the Calton Hill, near Edinburgh, Scotland; and on the*

Aqueous origin of Wacke; by J. W. Webster, M.D. of Boston.

The country around Edinburgh is extremely interesting to the geologist, and presents numerous instances of the junction of rocks to which the advocates of the Neptunian system have referred in support of their opinion as to the aqueous origin of greenstone, basalt, and wacke; while the same examples have been cited by the Volcanists, and by those who hold an intermediate opinion. The structure of a portion of Calton hill, where the most distinct alternations of [231] substances (whose aqueous origin none can dispute,) with pure and well characterized wacke are displayed, has not, as yet, I believe been particularly described.

Edinburgh is situated nearly in the centre of an extensive coal formation, where the usual sandstones and other coal measures are connected with the newer rocks of transition. From the coal field rise in many places beds of greenstone, in general forming small conical and round-backed hills. Other eminences are composed of amygdaloid, claystone, and other porphyries; and basalt and trap tuff occur in an overlying position. Of these, it is not my intention to speak otherwise than as conveying a general idea of the geological relation of the wacke above referred to.

The structure of Calton hill has been exposed by the recent improvements, and in particular by a section made in the construction of the new road to London. The rock occurring in greatest abundance, and which is probably the fundamental bed, is a porphyry, the basis of which in general is claystone, which in many places passes into felspar, in others becomes a distinct greenstone. Numerous veins of calcareous spar traverse it in different directions, and I am lately informed, that very beautiful examples of veins of greenstone of contemporaneous formation with the rock itself, have been discovered *in* the greenstone. Upon the porphyry rests a bed of trap tuff, upon this other beds of the two rocks repose, that at the summit being porphyry. The back of the hill (as we pass from the city) is a spot of peculiar interest, consisting of alternate thin beds of bituminous shale, sandstone, wacke, and clay ironstone, disposed in a manner which will be best understood by a rough outline taken on the spot.

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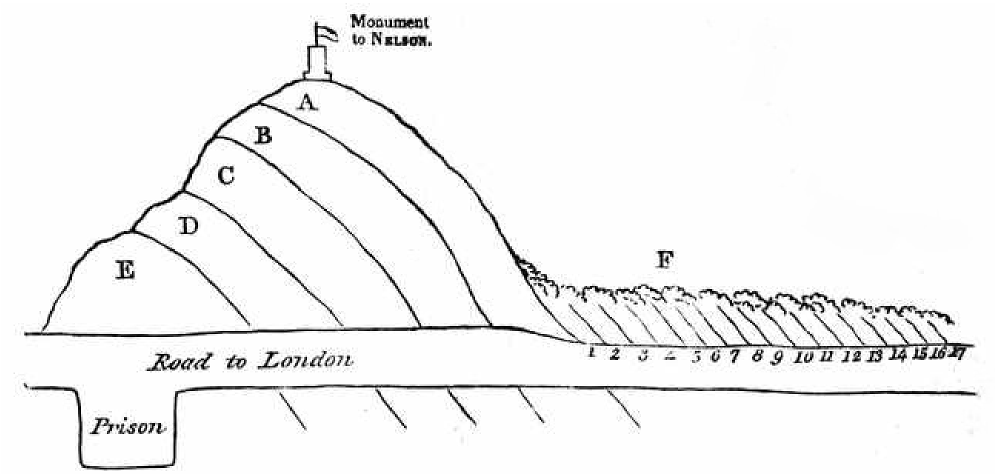

A Porphyry.	1 Bituminous shale.	7 Wacke, *with calc. spar.*	13 Wacke.
B Trap tuff.	2 Wacke.	8 Bituminous shale.	14 Bituminous shale.
C Porphyry.	3 Sandstone.	9 Wacke.	15 Wacke.
D Trap tuff.	4 Bituminous shale, with clay ironstone.	10 Bituminous shale passing on both sides into	16 Bituminous shale.
E Porphyry.	5 Wacke.	11 Wacke—and *calc. spar.*	17 Sandstone.
F Beds of wacke, &c. upper part concealed by vegetation.	6 Bituminous shale.	12 Bituminous shale.	

The wacke has a greenish gray colour, which is pretty uniform. The fracture is nearly even and [233] earthy, it is soft, yielding readily to the nail, and has a feebly shining streak. A slight stroke with the hammer causes the mass to separate in fragments of various size, the surfaces of which are often smooth and shining, each bed being composed of large distinct concretions, having a tendency to the prismatic form. This wacke fuses with difficulty before Brooke's blow-pipe. Specific gravity not determined, as it falls to pieces on being moistened.

The sandstone is for the most part gray, in some parts spotted red and brown, forming, as the section represents, the last stratum seen; the beds of sandstone are but a few inches in thickness, and the last (17) becomes less than an inch; it is probable, however, from the relative situation, from the dip and direction, that these strata are a continuation of others seen on the other side of the hill, where they are of sufficient thickness to have been quarried for the purposes of architecture. The *beds* of all rocks we know vary greatly in different parts, and it is not unusual for them to be some feet at one extremity, gradually decreasing till less than an inch in thickness at the other, or they may even be lost entirely, and gradually regain their former size; and it is not improbable that these beds of sandstone will be found to continue on towards the adjoining hills of Salisbury Craig and Arthur's Seat, passing under the greenstone and trap tuff.

The bituminous shale presents the usual characters; intermixed with it are numerous nodules of the common clay ironstone, the colour of which is a yellowish brown, these also frequently present characters common to the three substances, and throughout the beds, the passage from the one to the other is distinct. Whatever may be the opinions in regard to the origin of bituminous shale, there can be but one in regard to that of sandstone; and this has lately received no feeble support from the account given us by Dr. Paris, of a formation of this rock on the coast of Cornwall, where, says he, "we actually detect nature at work, and she does not refuse admittance into her manufactory, nor conceal, with her accustomed reserve, the details of the operations in which she is engaged." [234]

From the appearances which have been thus briefly noticed, no impartial geologist, we should imagine, would infer the *volcanic* origin of any portion of this formation; and if the aqueous origin of sandstone can be established, that of the wacke must be the same.

From its intimate connexion with the preceding subject, Dr. Webster subjoins the following:

Extract from a Paper on a recent formation of Sandstone, occurring in various parts of the Northern coast of Cornwall; by John Ayston Paris, M.D. F.L.S., &c. &c. Published in the Transactions of the Geological Society of Cornwall, 1818.

"A very considerable portion of the northern coast of Cornwall, is covered with a calcareous sand, consisting of minute particles of comminuted shells. That part which lies between St. Ives and Padstow is more immediately the subject of the present inquiry; a tract which, with a few exceptions, is entirely covered with this species of sand; and which in some places, has accumulated in quantities so great as to have formed hills of from forty to sixty feet in elevation. A considerable area, for instance, in the parishes of Gwythian and Phillack has been thus desolated, and several churches have been inundated. In digging into these sand hills, or upon the occasional removal of some part of them by the winds, the remains of houses may be seen; and in some places, where the churchyards have been overwhelmed, a great number of human bones may be found. The sand is supposed to have been originally brought from the sea by hurricanes, probably at a remote period."——"The sand first appears in a slight but increasing state of aggregation on several parts of the shore in the bay of St. Ives; but on approaching the Gwythian river, it becomes more extensive and indurated. On the shore opposite to Godrevy Island, an immense mass of it occurs, of more than a hundred feet in length, and from twelve to twenty feet in depth, containing entire shells and fragments of clay slate; it is singular that the whole mass assumes a striking appearance of stratification. In some places it appears that attempts have been made to separate it, probably for the purpose of building; for several old houses in Gwythian are built of it."——"It is around the promontory of New Kaye that the most extensive formation of sandstone takes place. Here it may be seen in different stages of induration; from a state in which it is too friable to be detached from the rock upon which it reposes, to a hardness so considerable, that it requires a very violent blow from a sledge to break it."——"But it is on the western side of the promontory of New Kaye, in Fistril Bay, that the geologist will be most struck with the formation; for here no other rock is in sight. The cliffs, which are high, and extend for several miles, are entirely composed of it."——"The beach is covered with disjointed fragments, which have been detached from the cliff above, many of which weigh two or three tons." [235]

There are three modes by which Dr. Paris conceives the lapidification of calcareous sand may be effected. 1st. "By the percolation of water through a hill of calcareous sand, by which it becomes impregnated with carbonate of lime." 2d. "The percolation of water through strata containing pyritical substances, by which it becomes impregnated with sulphuric salts." 3d. "The percolation of water through decomposing slate, or any ferruginous strata, by which it becomes impregnated with iron alumina, and other mineral matter."

Art. V. *Localities of Minerals.* [236]

To the Editor of the American Journal of Science, &c.

New-York, Dec. 21, 1818.

Dear Sir,

It is desirable that some mode should be adopted by which the public may become acquainted with all the *New American Localities of Minerals*, as they are discovered from time to time. With deference I would suggest, that in each number of your Scientific Journal, new localities might be recorded in alphabetical order, for present information and future reference.

The following localities, which have come under my observation, and which are probably not noticed in any work, are at your service.

1. *Agate.* Rolled mass: occurred near Powles Hook, New-Jersey.
2. *Apatite.* Truncated crystals of one inch, and amorphous; occurs in granite, chiefly in the felspar. Corlaer's Hook, vicinity of New-York.
3. *Brown Mammillary Hematite*, covering quartz crystals. Perkiomen lead-mine. Montgomery

county, Pennsylvania.

4. *Carbonate of Magnesia.* Structure earthy. Apparently a *pure* carbonate of magnesia. In mica slate, and granite; chiefly in the quartz. Roxborough, Philadelphia county.

5. *Common Jasper.* Traversed by veins of semi-opal. Small detached masses, frequently waterworn. Rhinebeck, Dutchess county, New-York.

6. *Compact Malachite.* Perkiomen lead-mine.

7. *Fetid Carbonate of Lime.* In ridges; and strata nearly vertical, sometimes containing petrifactions. Very frequent in Dutchess county, particularly in the neighbourhood of Rhinebeck Flats, and near Hyde Park. [237]

8. *Fibrous Talc.* In granite. Roxborough.

9. *Graphic Granite.* North River, near the city of New-York.

10. *Graphite.* In a calcareo-siliceous gangue. Corlear's Hook.

11. *Native pulverulent* (or rather granular) *Sulphur*. In pyritical quartz. Barren Hill, Montgomery county, Pennsylvania.

12. *Plumose Asbestus.* Corlaer's Hook.

13. *Semi-opal.* In common Jasper—(which see.)

14. *Scaly Talc.* In granite. Roxborough.

15. *Stellated Quartz.* Perkiomen lead-mine.

16. *Sulphate of Barytes.* In sulphuret of lead and silver. Livingston's lead-mine, Columbia county, New-York.

17. *Sulphuret of Silver.* With sulphuret of lead. Same locality.

18. *Tourmalin.* In masses of crystalline quartz. Rhinebeck.

Very respectfully,

F. C. SCHAEFFER.

The following notices were prepared before the receipt of the above letter.

Other Localities of Minerals and of ANIMAL REMAINS, *and acknowledgments of Specimens received.*

Guadeloupe.—Native sulphur, obsidian, pitchstone, native alum, basaltic hornblende, alum covered with sulphur.

Porto Rico.—Hexagonal crystals of mica.

Specimens of the above minerals are in the cabinet of Mr. John P. Brace, at Litchfield, Connecticut.

Molybdena is found in Shutesbury, Massachusetts, near Northampton, east of Connecticut River, on the land of William Eaton. It is the common sulphuret, but remarkably beautiful and well characterized. Its colour is nearly that of bright lead, very brilliant, smooth, and almost unctuous; soft, flexible, distinctly foliated, and the folia are very thin, and easily separable, almost like mica. It gives the usual greenish trace on white pottery, while a line drawn parallel on the same basis, by a piece of plumbago or black-lead, is black; this being (as pointed out by Brongniart) the easiest criterion, by which to distinguish between molybdena and plumbago, or black-lead. We have many times applied it with entire success. [238]

This molybdena, from Shutesbury, is chiefly crystallized, and the crystals are, in some instances, very distinct; their form is that of a flat six-sided prism, or what is commonly called a table. The rock, from which they were obtained, is a granitic aggregate, (judging from the specimen sent, it may be a true granite) and the forms of the crystals are very distinctly impressed in the stone, so that when removed they leave an exact copy or crystal mould. In a letter from the proprietor of the land, it is said that the molybdena is found in a ledge of rocks, six or seven feet above the surface of the earth, and about ten or twelve feet above the level of the water; the direction of the rocks is from S. to N. E. by N.; the metal is in a vein, running E., and was discovered in small pieces in the top of the ledge. After putting in two blasts, some large pieces were obtained.

From this account, and from the specimens, (some of the crystals being an inch or more in length) this must be one of the most interesting localities of molybdena hitherto observed in this country; and it is hoped Mr. Eaton will take some pains to procure and furnish specimens.

Rose Quartz.—From Southbury, Connecticut, not far from Woodbury, and from the Housatonick River, two young men, of the name of Stiles, have brought us specimens of *rose quartz*, of delicate and beautiful colour. It is said to be abundant in a ledge of the same substance.

Plumbago.—In Cornwall, Litchfield county, Connecticut, plumbago is found, of a good quality, and in considerable masses, in a vein contained in a rock of gneiss, or mica-slate. It has been known a good while, and is said to have been exported anterior to the American revolutionary war. [239]

Coal, &c. in Zanesville, Ohio. Through the kindness of the Rev. Dr. Bronson, Principal of the Cheshire Academy, we have received the following information.—In cutting a canal in the above town, in the spring of 1817, through freestone, trees, and fish, and other substances, both animal and vegetable, were taken out, alike petrified to a freestone, excepting the bark of a beach tree, which was very perfect and beautiful coal—(as we have had an opportunity of ascertaining, from an examination of the specimens.)

Coal, in the county of Muskingum, Ohio. Common stone-coal, highly bituminous, (the slaty or black coal of Werner,) is found abundantly.

South of Lake Erie, about 25 miles, in the bed of Rocky River, are found shells, and other animal remains, imbedded in argillaceous iron; the specimens were collected in 1817, by the Rev. R. Searle.

Mammoth's Tooth, from the River St. Francis, west of Mississippi. Return J. Meigs, Esq. has transmitted, through the Rev. E. Cornelius, a mammoth's tooth, apparently not mineralized. It appears to have belonged to a very old animal, as the processes, (which, it is well known, are commonly very prominent) are worn down smooth, and some of them almost obliterated.

Blue Ridge, Tennessee, and Mississippi Territory.—Through the kindness of the Rev. E. Cornelius, and of Mr. John H. Kain, we have received a considerable collection of specimens, illustrative of the mineralogy and geology, and Indian antiquities of these regions; they may be, on a future occasion, the subject of more particular remarks.

Coal, in Suffield, Connecticut, on the river of the same name. From Mr. Nathan Stedman, we have received specimens of coal, found in thin veins, in rocks of slate, and argillaceous sandstone, on the banks of the river. The veins are thin, but considerably numerous; the coal is [240] very glossy and black; breaks with a smooth and almost conchoidal fracture, and very much resembles jet. It is very much intersected by thin veins—(not thicker than a knife-blade)—of white crystallized calcareous spar. This coal is bituminous, and burns pretty freely. It has not been explored, except superficially.

Coal, in Southington, Connecticut. Beds of slate are found more or less bituminous; and, at the bottom of some of the wells, the slate begins to exhibit thin veins of coal, distributed in great numbers through the substance of the slate, which is the shale of the miners. The coal is from the thickness of a knife-blade to that of a finger; it is highly bituminous, and burns with great freedom. Even the entire masses of the stone burn brilliantly, when ignited on a common fire; and, after exhaustion of the coally matter, leave the slate of a grayish colour.

The locality from which the specimens were taken, is on the land of Roswell Moore, Esq. about midway between Hartford and New Haven. The spot was lately examined by Col. Gibbs, Eli Whitney, Esq. Professor Olmstead, and others; and arrangements are making to bore the strata, to the depth of several hundred feet, if necessary. These localities are in what may, with propriety, be called the coal formation of Connecticut. Coal has been found in several other places in that state; and the peculiar geological features of the region in which it is contained, are very interesting, and may hereafter be described in form.

Sulphat of Barytes, with Coal, &c.—Sulphat of barytes exists abundantly in Southington, on what is called the Clark Farm. With quartz, carbonate of lime, &c. it forms the gangue of a metallic vein, containing galena, or sulphuret of lead, copper pyrites, &c. The sulphat of barytes is more or less crystallized, and principally in the form that is called the coxcomb spar. The same vein, although it is in the side of a mountain, several hundred feet above the flat country adjacent, and two or three miles from the coal strata above mentioned, contains numerous spots and patches of coal, very much resembling that at Suffield. It is of a most brilliant black, and [241] contrasted with the white, stony matrix, (principally quartz and sulphat of barytes) in which it is enveloped, it forms elegant specimens.

Scintillating Limestone.—In Vermont, a singular scintillating limestone is found, of which an account is given in the following extract of a letter from Mr. George Chase, dated Randolph, February 19, 1818.

"The object of the present letter is to acquaint you with a circumstance relating to the limestone that abounds in this primitive country, which to me is inexplicable. This carbonate of lime is of a pale sky-blue colour; effervesces strongly with nitric acid; and, by burning, produces lime, so that there is no question as to the identity of the mineral. But it likewise gives forth sparks with steel:—this I concluded, at first, to be an accidental circumstance; but every specimen that I have tried, from various quarters of the country, uniformly gives fire with steel. The limestone is found in layers, in blocks, and masses, disseminated among the clay-slate that covers the greatest part of the townships in this vicinity. When first taken from the earth, and exposed to the air, it is covered with an incrustation of a dark reddish-brown colour, that crumbles easily between the fingers, and is generally from one inch to a foot in thickness. This incrustation, however, hardens on a long exposure to the air. This led me to think that the incrustation was owing to the decomposition of the limestone, which was produced by the sulphuret of iron, intimately disseminated through the rock, which would also explain the singular circumstance of its striking fire. But on dissolving a small quantity of the mineral in nitric acid, and adding a drop or two of the decoction of gallnut, no discolouring of the liquor was produced."

Limpid Quartz.—West Canada Creek, a northern branch of the Mohawk, affords, in its sands, small crystals of quartz, limpid, and terminated at both ends by pyramids of six sides; we are indebted for specimens to Professor Fisher.

Fetid Primitive Limestone, &c.—From the vicinity of Williamstown College, through the kindness of Professor Dewey, we have received specimens illustrative of the geology of that [242] region. Among them is limestone from Stockbridge, crystallized in large plates and rhomboids, almost white, and still fetid on being rubbed, which is very different from most fetid limestones, which are dark coloured, and even black, and do not belong to primitive formation.

Molybdena.—In Pettipaug, Saybrook, Connecticut, molybdena occurs. It is mentioned in the Review of Cleaveland's Mineralogy, and is here cited again for the purpose of pointing out its locality more exactly. It is found about half a mile to the E. of the Turnpike leading from Saybrook to Middletown, on the first road on the right hand above the turnpike gate, near the house of the widow Pratt. It is not far from Pettipaug meeting-house, in a northern direction.

Beryl.—In Haddam, Connecticut, are found many beryls, and some of uncommon size; an account of one of the most remarkable localities is contained in the following memorandum from the Rev. Mr. Mather, to whom we are indebted for specimens.

"The place in which the beryls are found is in the town of Chatham, about one mile and a half north from Middle-Haddam landing; about half of a mile S. W. of a large hill, on which is the cobalt mine. The rock in which the beryls are contained is granite; the parts of which are very large, especially the felspar and the mica. Large masses of shorl are also found in these rocks. Beryls have also been found in other parts of Middle-Haddam, amongst rocks of the same description. The *greatest* diameter of the largest beryl is four inches; the *least* three inches. The beryls are numerous, and of different sizes; though few are less than an inch, or two inches in diameter. The length of the longest beryl is five inches."

Clay.—Near Delhi, New-York, a few rods from the Delaware river, are found beds of clay, of which specimens have been transmitted by Mr. John P. Foote, of New-York. We are of opinion that they are not porcelain clay.

Gypsum.—Cayuga Lake. We are informed by Dr. L. Foot, that the workmen who have excavated [243] about 20 feet on the border of the lake, in gypsum, which is generally of a dark brown, or black colour, when they come to a transparent crystallized piece, call it isinglass, and reject it as worthless: the hint should be remembered by mineralogists, that the specimens may be saved for their cabinets.

ASBESTOS IN ANTHRACITE.

Extract of a letter from Dr. I. W. Webster.

BOSTON, 27th Nov. 1818.

DEAR SIR,

In examining some masses of the anthracite from Rhode Island, one piece attracted my attention, from the waved structure of the lamellæ into which it separated. The fragments of this were wedge-shaped, and I found the space between some of the laminæ filled up by a fibrous, silky substance, which induced me to break up other masses, in one of which I discovered an abundance of amianthus; the filaments are of a light-green colour in some parts of the mass—in others presenting different shades of brown. With a microscope, I found the fibres intermixed with the anthracite; or forming thin layers, and these sometimes parallel to, at others crossing, in different directions, the course of the laminæ. How far the presence of this mineral may influence the ignition or combustion of the coal, is a question, perhaps, worth determining. Should my engagements permit, I shall make further examination, and inform you. In the mean time, the notice of this fact may call the attention of some of your readers to the subject. At any rate, this substance has, I believe, never before been noticed in connexion with anthracite, and is highly interesting in a geological point of view.

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REMARKS.

We have been familiar with the Rhode Island anthracite, and with the formation of rocks in which it is found; and, long since, observed the fact mentioned by Dr. Webster. The asbestos often is in the form of the most delicate amianthus, frequently blended also with the slate rocks, which form the roof and pavement of this coal. A specimen now lies before us, in which a complete vein of this amianthus, with fibres nearly two inches *in length, connects and pervades* a mass of slate, supposed to be of the transition class.

Similar facts are mentioned also by Dr. Meade, in his account of the Rhode Island coal.

RED PYROXENE AUGITE.

Extract of a letter to the Editor, from Dr. H. H. Hayden of Baltimore.

I have very lately discovered a couple of small specimens of the transparent *red* pyroxene, resembling fine crystals of titanium, which I, at first, mistook it for. One of them is contained in the middle of a large crystal, like the rubellite in the green tourmalins of Massachusetts, but it is not the same substance. The pyroxene, which I have reference to, is the olive-coloured epidote of some, pistazite of others, but resembles, in this instance, the sahlite; the crystals being divisible longitudinally. Some of them are five inches long, and half an inch diameter, hexaedral and double; that is, two joined together, as described by Brochant in particular.

Some other localities, of which we have received notices, may be mentioned in a future number.

BOTANY.

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Art. VI. *A List of Plants found in the neighbourhood of Connasarga River, (Cherokee Country) where Springplace is situated; made by* Mrs. Gambold, *at the request of the Rev. Elias Cornelius.*[32]

A.

Acer rubrum and Sacharium
Acanitum uncinatum
Actæa racemosa
Adianthum Capillus Veneris
Aesculus Pavia
Agave
Agrimonium Eupatorium
Aira pallens
Aletris farinosa
Alisma Plantago
Allium, 2 sp.
Amasonia latifolia
Anchusa
Andromeda arborea and other sp.
Andropogon alopecuides and ambiguum
Anemone hepatica, Thalictroides, virginiana, and pennsylvania
Angelica lucida and other sp.
Annona
Antirrhinum elatine
Apocynum cannabinum
Aquilegia canadensis
Arabis
Aralia spinosa
Arctatis caroliniana
Arethusa parviflora
Aristoloichia serpentaria, 3 sp.
Arum sagittæfolium and triphyllum
Arundo tecto
Asarum virginicum
Aselepias purpurascens, variegata, verticillata and others, tuberosa
Ascyrum
Asplenium
Aster concolor, linarifolius, and many others
Avena palustrio and spicata
Azalea viscosa, and others.

B.

Berberis canadensis
Betula alnus
Bidens pusilla N. S. Muhlenb.
Bignonia crucigera and radicans
Bucknera americana.

C.

Cacalia
Calycanthus floridus
Campanula perfoliata and divaricata
Cardumine virginica
Carduus, several sp.
Carex, N. S.
Cassia chamæcrista, marilandica, nictitans, and Tora
Ceanothus americanus
Cephalanthus occidentalis
Cerastium arvense
Cercis canadensis
Chelone glabra and Penstemon
Chenopodium ambrosioides and anthelminticum
Chionanthus virginicus
Chironia campanulata and other sp.
Chrysogonum virginicum
Cimicifuga pulmata
Circea lutetiana
Cissampelos smilacine
Claytonia virginica
Clematis ochraleuca and virginiana
Clitoria mariana and virginiana
Collinsonia virginica

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Commelina erecta, longifolia virginica
Convallaria multiflora and racemosa
Conyza linifolia
Coreopsis auriculata, bidens, senifolia, tripteris, alternifolia and verticillata
Cornus florida
Corylus americana
Crætægus apiifolia
Crotallaria sagittalis
Cucubalus behen
Cuscuta americana
Cynanchum
Cynoglossum officinale and virginicum
Cynosurus indicus and sparsus
———— filiformis (Muhlenb.)
Cypripedium acaule, alba and calceolus

D.

Delphinium exaltatum
Dentaria multifida
Diodia N. S. and virginica
Dioscorea
Diospyros virginiana
Dodecatheon media
Dracocephalon virginianum

E.

Echium vulgare
Elephantopus caroliniensis
Eleusine filiformis
Epilobium coloratum
Erigeron pulchellum, and other sp.
Eryngium aquaticum ovalifolium and yuccæfolium
Erythronium dens canis
Eupatorium cœlestinum, perfoliatum, and urticæfolium
Euphorbia colorata, ipecacuanha, and other sp.
Evonymus virginicus

F.

Fagus castanea dentata sylvatica atropunicea
Festuca nutans, palustris and sylvatica
Fragaria vesca
Fumaria N. S.

G.

Galactia mollis
Galax aphylla
Galega hispidula and virginica
Galium, several sp.
Gerardia asgelia, hydrophylla, lancifolia and purpurea
Geum rivale
Gleditsia spinosa

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Gaura sp.
Gentiana saponaria, and others
Geranium, 2 sp.
Glycine apios and tomentosa parabolica (Muhlenb.)
Gnaphalium germanicum, and others

H.

Hedyotis sp.
Hedysarum prostratum, and others
Helianthus angustifolius. sp. nova.
Heuchera
Hibiscus
Houstonia cœrulea, purpurea, and varians
Hydrangea glauca
Hypericum fasciculatum, nudiflorum, prolificum, and others
Hypnum sp.
Hypoxis erecta.

I.

Ilex aquifolium sp.
Impatiens noli tangere
Inula graminifolia and mariana
Ipomœa, sky blue, and other sp.
Iris, low, sweet-smelling blossoms in spring, and other sp.

J.

Jutropha stimulosa
Juglans alba acuminata
—— —— ovata
Juglans nigra
—— oblonga alba
Juncus bicornis and tenuis

K.

Kalmia latifolia
Kyllingia triceps

L.

Laurus benzoin and sassafras
Lechea minor
Lepidium sp.
Liatris graminifolia, spicata and squarrosa
Lilium martagen
Limodorum tuberosum
Linum virginicum
Liquidamber styraciflua
Liriodendrum tulipifera
Lobelia cardinalis, inflata, kalmii, puberula and siphylitica
Lonicera erecta and symphoricarpos
Ludugia alternifolia jussiæoides
Lupinus sp.
Lycopodium apodum and rupestre
Lycopsis
Lycopus virginicus
Lysimachia quadrifolia and punctata
———— sp.
Lythrum lineare and strictum.

M.

Malaxis unifolia
Marchantia polymorpha
Melanthium latum [248]
———— sp.
Melica speciosa
Melissa nepeta
Menispermum carolinianum
Mespilus several sp.
Mimosa horridula
Mimulus ringens
Mitchella repens
Momordica sp.
Monarda punctata
Monotropa several sp.
Morus.

O.

Oenothera biennis, lineanis, and others
Ophioriza mitreola
Ophrys cernua
——— sp.
Orchis ciliaris unifolia
Orobanche uniflora
Oxalis, 2 sp.

P.

Panax ginseng
Panctratium carolinianum
Pancium nitidum
Parietaria pennsylvanica
Parnassia caroliniana
Parthenium integrifolium
Passiflora incarnata and lutea
Paspalium ciliatifolium
Pedicularis canadensis
Penstemon lævis
Penthorum sedoides
Phlox ovata, paniculata and pilosa
Phryma liptostachia
Physalis pubescens, several sp.
Phytolacca decandra
Pinus, several sp.
Plantago major and virginica
Poa nervata
Podophyllum peltatum
Polygala cruciata, incarnata and lutea
Polygonum hydropiper, and other sp.
Potentilla reptans
Prenenthes trifida
Prunella vulgaris
Prunus cerasus virginiana, and others
Psoralea melilotoides
Pyrola, 2 sp.
Pyrus malus coronarius

Q.

Quercus alba, 2 sp.
———— nigra, various sp.
———— rubra
Quercus prinus
———— Phellos
Queria canadensis

R.

Ranunculus bulbosus, and other sp.
Rhexia mariana
Rhus toxicodendron, and others
Ribes sp.
Rosa, several sp.
Rubus fruticosus, hispidus and occidentalis
Rudbeckia fulgida, hirta and purpurea
Ruellia

S.

Sagittaria sagittifolia
Salix tristis and others
Salvia lyrata and urticæfolia [249]
Sambucus nigra
Sanicula marilandica
Sanguinaria canadensis
Saururus cernuus
Scabiosa sp.
Schisandra
Schoenus sparsus
Scirpus retrofractus
Sentellaria hyssoppifolia, parviflora, and others
Sedum, a low plant, fl. white
Senecio sp.
Serratula præalta, scariosa and spicata
Sida rhombifolia and spinosa
Silene antirrhina, and another sp.
Sisyrinchium Bermudiana
Sisymbrium nasturtium
Sium sp.
Smilax sarsaparilla and other sp.
Smyrnium aureum
Solanum nigrum
Solidago nova boracensis, rigida, virga aurea and others.
Sonchus sp.
Sophora fl. purple
Spigelia marilandica
Spiræa aruncus, apulifolia, stipulaica, tomentosa and trifoliata
Staphylæa trifoliata
Stellaria sp.
Styrax sp.
Sylphium N. S.
———— compositum.

T.

Tabernamontana latifolia
Teverium canadense
Thalictrum, various sp.
Thlaspi bursæ pastoris
Thymus virginicus
Tradescantia virginica
Tragopogon dandelion
Trichodium laxiflorum and procumbens
Trichostema dichotoma
Trifolium (Buffalo)
Trillium cernuum, luteum, sessile, and another sp.
Triosteum angustifolium

U.

Ulmus, 2 sp.
Uniola latifolia
Uvularia sessilifolia.

V.

Vaccinium, several sp.
Verbascum lychnitis
Verbena officinalis
Verbesina sp.
Veronica virginica
Viburnum, several sp.
Viola, several sp.
Viscum
Vitis, several sp.

X.

Xanthium strumarium
Xantoxylon tricarpon

Y.

Yucca filamentosa.

Acer rubrum.—The inner bark boiled to a sirup, made into pills, and these dissolved in water, is used in cases of sore eyes; the eyes washed therewith. [250]

Actæa racemosa.—The root in spirits, these made use of in rheumatic pains.

Adianthum Capillus Verenis.—A decoction of the whole plant, used as an emetic in cases of ague and fever. A very strong medicine.

Aesculus Pavia.—The nuts pounded, are used in poultices.

Agave.—The root is chewed in obstinate cases of diarrhœa with wonderful success. It is, however, a very strong medicine.

Allium.—The Indians are fond of, for culinary purposes.

Angelica.—The same.

Annona.—Of the bark they make very strong ropes.

Aralia spinosa.—A decoction of the roots roasted and pounded, (green, they are poisonous) is given as an emetic. A very strong one.

Asarum virginicum.—The leaves dried and pounded, are used for snuff; fresh, they are applied to wounds.

Bignonia crucigera.—Tea made of the leaves cleanses the blood.

Calycanthus floridus.—The *roots* are used as (though very strong) emetics. The *seeds* to poison wolves.

Carduus.—various species. The roots used in poultices.

Cercis canadensis.—Children are fond of eating the blossom.

Coreopsis auriculata.—The whole plant is much used in colouring. It affords a *red* colour.

Cornus florida.—The bark of the root is used to heal wounds, and in poultices.

Ilex.—Of the wood, spoons are made. The berries of service in colics.

Juglans oblonga alba.—A kind of pills are prepared from the inner bark, and used as a cathartic.

Liquidamber styraciflua.—The gum is used for a drawing plaster. Of the *inner* bark a tea is made for nervous patients.

Liriodendrum tulipifera.—Of the bark of the root a tea is made, and given in fevers. It is also used in poultices.

Melanthium.—The root is a crow poison; and a sure, but severe cure for the itch. [251]

Pinus.—Boil the root, skim off the turpentine, spread it on Deer's skin (tanned,) for a drawing plaster.

Podophyllum peltatum.—A sirup is boiled of the root, and given for a purgative, two pills at a time. A drop of the juice of the fresh root in the ear, is a cure for *deafness*. (So I have been told, I never witnessed it.)

Potentilla reptans.—A tea of it is given in fevers.

Prunus cerasus virginiana.—Of the bark a tea is made, and drunk in fevers.

Quercus alba.—The bark is used for an emetic.

Quercus nigra and *rubra*.—A die for leather.

Rosa.—The roots boiled, and drunk in cases of dysentery.

Rubus fruticosus.—The root good to chew in coughs.

Sanguinaria canadensis.—The root is used for the *red* die in basket making.

Saururus cernuus.—The roots roasted and mashed, used for poultices.

Solanum nigrum.—When young, made use of as the best relished potherb.

Solidaga virga aurea.—A tea much made use of in fevers.

Sophora.—A blue die.

Spigelia marilandica.—In cases of worms.

Spiræa stipulaica and *trifoliata.*—The whole plant a very good emetic. Of a strong tea or decoction thereof, a pint is drunk at a time.

Tradescantia virginica.—The leaves much relished greens for the table.

Yucca filamentosa.—The roots pounded and boiled, are used instead of soap to wash blankets; likewise to intoxicate fishes, by strewing them pounded on the water. The same is done with *Æsculus*.

Art. VII. *Description of a new species of Asclepias. By Dr.* Eli Ives, *Professor, &c. in the Medical Institution of Yale College*. (*With a Plate.*) [252]

The plant, which is the subject of the following observations, is found growing abundantly on the sandy plains east of Cedar Hill, in New-Haven. It is locally associated with the asclepias viridiflora and verticillata. When this species of asclepias was first noticed by me, it was supposed to be a variety of viridiflora of Rafinesque and Pursh; but after examining a great number of specimens, it was found that the varieties did not blend themselves. The leaves of the viridiflora being uniformly oblong and obtuse, the leaves of the other uniformly lanceolate and acute. To this new species I purpose to give the name Lanceolata.

Specific character of the asclepias lanceolata:—Stem decumbent, hirsute; leaves opposite, lanceolate, acute, sub sessile, hirsuit umbels lateral, solitary, sessile, nodding, subglobose, dense-flowered; appendage none. See the plate.

The asclepias lanceolata is allied to the asclepias longifolia and viridiflora by the absence of appendage or horn of the nectary. It is distinguished from the longifolia, which is characterized by alternate linear leaves, and umbels erect.

Asclepias lanceolata.

The asclepias lanceolata and asclepias viridiflora belong to Mr. Elliott's genus acerates. In both, the nectary or stamineous crown is short concave, and oppressed to the angles of the filaments.

Art. VIII. *Description of a New Genus of American Grass.* Diplocea Barbata, by C. S. Rafinesque, Esq.

Diplocea. *Generic definition.* Flowers paniculated monoical or polygamous. Exterior glumes membranaceous bivalve one to three flowered, valves subequal emarginated mutic. Anterior glumes bivalve unequal, the largest notched, notch aristated, the smallest mutic entire bearded. [253] *Additional characters.* Flowers when single sepile with a lateral jutting peduncle, when double, one sepile and one pedunculated, when three two are pedunculated and alternate. The hermaphrodite and male flowers are similar: the female are nearly clandestine, inferior. Stamens 3, styles 2. Seeds ovate oblong.

Observations. This genus is intermediate between *amphicarpon*, Raf. (*Milium amphicarpon*, *Pursh*) and *aira*, L. It differs from this last by its polygamy, variable number of flowers, notched valves, &c. The generic name means *double notch*. Its type is the following species, which had been ranged with the *aira*, by Walter, and considered doubtful by Pursh.

Diplocea Barbata.

Specific definition. Stems cespitose, articulations bearded; leaves rough glaucous, neck ciliated; panicles, few flowered, female axillary; largest valvet rinervate, and ciliated as well as the awl.

Latin definition. Caulibus cespetosis, geniculis barbatis, collo ciliato, foliis scabris glaucis, paniculis paucifloris, femineis axillaribus; valva majore trinerva, aristaque ciliata.

Description. Roots, annual fibrous: stems many, unequal, rather procumbent at the base, next assurgent, rising one foot at utmost; they are geniculated, slender, brittle, weak, and smooth. The knees or joints are bearded, the sheaths are split, the neck ciliated, the leaves short, stiff, rough glaucous, linear acute, obscurely striated. The panicles have few flowers, particularly the female ones, which are axillary coarctated almost hidden, while the male are terminal and divaricate: some hermaphrodite flowers are occasionally, but seldom found among both panicles; they are all similar, differing only in the want of stamina or pistils. The valves of the exterior glumes are nearly equal oblong notched obtuse, mutic and oneneroed. The valvules or valves of the glumule (corolla or interior glume) are unequal, the largest is ciliated trinerve bifid, with a soft ciliated awl in the notch, as long as the valve: the small valve is ovate acute concave, very hairy on the back. The colour of the flower is reddish or pale red; but variable. [254]

Observations. This plant is probably the *aira purpurea* of Walter, Pursh, Elliott, &c. but does not belong to that genus. It was found in Carolina, but I have found it on Long-Island, near Gravesend, Bath, Oyster-Bay, &c. on the sandy and gravelly sea-shore: it grows probably in the intermediate states. It blossoms in August and September, has no particular beauty, but a very singular appearance. The specific name of *purpurea* was improper, since the colour of the flowers is variable from whitish to red.

ART. IX. *Floral Calendar, &c.*

To the Editor of the American Journal of Science, &c.

PLAINFIELD, October 17, 1818.

SIR,

Should the following calendar be thought worthy of a place in your Journal, you will please to insert it. Though very brief, it will show that vegetation is considerably later on the range of mountains, on which this place is situated, than in the level parts of our country.

Yours truly,

J. PORTER.

Floral Calendar for Plainfield, Massachusetts, 1818. By JACOB PORTER.

March 13. Robins and bluebirds appear.

April 25. Claytonia in flower. A considerable part of the ground is covered with snow, which, in many places, is 2 or 3 feet deep.

April 27. Observed the claytonia, blue violet, strawberry, and a species of sedge, in blossom, at Worthington. [255]

May 1. Hepatica, roundleaved violet, and erythronium in flower.

May 10. Chrysosplenium, or golden saxifrage, in flower.

May 15. The large trillium, or purple wakerobin, in flower.

May 18. Uvularia, or cellwort, and white violet, in flower.

May 19. A fall of snow, so that the ground at night was almost covered with it.

May 22. The beautiful coptis, or goldthread, in flower.

May 25. Ash and beech in flower.

May 26. Sugar-maple, viburnum, threeleaved arum, blue violet, small panax, prostrate mitella, fly honeysuckle, white berried gaultheria, and umbelled Solomon's seal, in flower.

June 17. Absent, since my last date, on a tour to New-York. Four other specimens of Solomon's seal, trientalis, azalea, 2 species of crowfoot, blue-eyed grass, medeola, moose-bush, and several species of vaccinium, in flower. The small trillium, or smiling wakerobin, sarsaparilla, and dentaria, blossomed during my absence.

June 22. Small enothera, 2 species of veronica, and the golden senecio, in flower.

June 23. Mountain ash, Norway potentilla, sanicle, and the lovely linnea in flower.

June 28. Prunella, and red and white clover, in flower.

June 29. Mitchella, in flower.

June 30. Yellow diervilla, in flower.

July 1. Climbing corydalis, in flower.

July 4. The fimbriate archis, and roundleaved pyrola, in flower.

July 5. Spiked epilobium, and roundleaved mallows, in flower.

July 6. Mullen, in flower.

July 7. Small geranium in flower.

July 8. Another species of epilobium, in flower.

August 18. Frost this morning.

ZOOLOGY. [256]

Art. X. *Notes on Herpetology, by* Thomas Say, *of Philadelphia*.

(Communicated by the Author.)

Although I have not devoted a particular study to this department of the science of nature, yet I have been amused and instructed by casually observing many of the subjects of it, when I have been rambling in their native haunts, pursuing objects more particularly interesting to me.

But when perusing, the other day, the account of the copper-head of our country, by Mr. Rafinesque, I was impelled to ask for information on the subject, through your useful publication, in which that account appeared, and to make, at the same time, a few miscellaneous remarks or notes. These are in part included in the present essay, and if they should have a tendency to incite attention to the reptilia of the United States, at present in a state of confusion and incertitude, some portion of benefit will be rendered to the great cause of science.

I think that a moderate degree of labour and observation bestowed upon the investigation of the species already described, would prove the unity in nature of some species which have been considered as distinct by all the authors, would detect many errors in observation, expose some deceptions practised on credulity by the designing, and would enable us to fix, with some degree of accuracy, our knowledge of truth and of the species.

A work devoted particularly to this class, by some one adequate to the task, who could have in his view all the known species, is indeed a desideratum.

Scytale cupreus, Copper-head, &c. of Mr. Rafinesque. I have always considered the Copper-head to be no other than the *Cenchris mockeson* of authors, and *Boa contortrix of Linn.* v. Latr. [257]
Lacep. Shaw, Daudin, &c. *Agkistrodon mokasen* of Beauvois; which opinion is not a little corroborated by an actual comparison of one of these animals in Peale's Museum, with the descriptions of the authors above mentioned. It may be objected to me, that the *mockeson* of those naturalists is a *Cenchris*, and not a *Scytale*, therefore generically distinguished from the Copper-head; but on the other hand, we know that the genus *Cenchris* does not exist in nature, that the individual upon which it was founded, was either a fortuitous variety, or that the illustrious naturalist was deceived by the desiccation of his specimen, giving to the basal caudal plates a bifid aspect. That the former was the case I analogically infer, from having seen, in the collection of the Academy of Natural Sciences, a *Coluber heterodon*, of which the fifth and sixth pairs of caudal scales were entire, and not as usual bifid. An additional corroboration of the truth of this inference is derived from the circumstance of the *Scytale* of Peale's Museum, having the ten or eleven apical caudal plates bifid, precisely as in the genus *Acanthophis*, to which it seems closely affianced, and to which it would be referred if this character was a permanent one. In every other character this specimen coincides with the *S. mockeson* of authors, and in every necessary respect with the *S. cupreus* of Mr. R. with the sole exception of the calcarate termination of the tail. This caudal horn seems to approximate Mr. R's. animal to the *S. piscivorus* or true horn-snake, about which the credulous have so absurdly alarmed themselves, and which was arranged with the *Crotali* by Lacepede, in consequence of having a horn on the tail an inch long. We find sometimes a small indurated tip to the tail of *Coluber melanoleucus*,[33] at least upon some full grown specimens, formed by the elongation and appression of the terminal scales; a larger one on that of the European viper, and of the *Acanthophis cerastes*, and *Brownii*. Mr. Peale's specimen certainly has not the horn, but it has at the termination of the tail [258]
a scale somewhat longer and more indurated than the others, the individual had not attained his full growth. If then this species (and some others) is subject to vary in the form of its caudal plates, from which the generic characters are in part estimated, may it not also vary in the armature of the tail, which at most can only be considered as specific. The Copper-belly is a very distinct species. If the *S. cupreus* is, notwithstanding the above observations, considered a distinct species, it would gratify those who cultivate natural history, to have some good discriminative characters of it.

Much has been said and written about antidotes to the venomous bites of snakes, and Mr. Rafinesque enumerates over again several plants which have been said to be, and which he appears to believe to be specifics. If the case was my own, I would be very unwilling to rely upon either of the 20 or 30 medicinal plants, dubiously mentioned by the late Professor Barton, as reputed antidotes for this poison. It would be more prudent to resort unhesitatingly to a more certain remedy, in the ligature, and immediate excision of the part, where such an operation was practicable, or to cauterization, if the part could not be removed by the knife.

In conversation with Professor Cooper upon this subject, he informed me that in his domestic medical practice he applied common chalk to the wounds occasioned by the stings of hymenopterous insects. That in consequence of this mode of treatment, the pain was immediately allayed, and the consequent inflammation and intumescence were prevented. The experiment which led to this result was induced by the supposition that the venomous liquid might be an acid, which opinion was, in some degree, justified by the event.[34] Upon the same neutralizing principle it must be supposed that any alkali would be beneficial. The learned Professor supposed, that the venom of the poisonous reptilia may, in like manner, be an acid secretion, and recommends this to be ascertained by experiments upon the liquid itself.

If this inference proves correct, the same alkaline remedy may be employed to neutralize, or so modified as to stimulate, in case, as is supposed by some, the poison produces upon the system a [259]
typhoid action.

An instance however is related in the Trans. Royal Soc. of Lond. of the unsuccessful administration of the vol. alkali in case of the bite of a Rattle-snake; and an intelligent physician of Georgia informed me, that he had applied the same stimulant in vain for the cure of the bites of poisonous snakes, but that being once stung by a Scorpion, he was instantaneously relieved by the topical use of this liquid. He further related to me a cure performed under his observation, by means of the singular antidote, which has often been resorted to in case of snake bites, that of the application of a living domestic fowl or other bird directly to the wound; three fowls were applied in this instance, of which two died in a few minutes, it was supposed, by the poison extracted from the wound. This account, from an observant medical professor, (who may nevertheless have been deceived) acquires some additional title to consideration by a similar event which lately occurred at Schooley's Mountain, New-Jersey. We are informed from a respectable source, that a boy was there bitten by a Copper-head, (Scytale mockeson.)[35] The part was immediately painful, became swollen and inflamed, and the sufferer had every appearance of having received a dangerous wound. A portion of the breast of a fowl was denudated of feathers, and applied to the wound; in a few minutes the fowl died, without having experienced any apparent violence or injurious pressure, from the hand of the applicant, the breast exhibiting a livid appearance. Another living fowl was then laid open by the knife, and the interior of the body placed upon the wound. The wound was subsequently scarified, and variously administered to. The boy however recovered, and his cure was generally attributed, at least in part, to the application of the birds. I am as far as any one from relying implicitly upon this mode of treatment, and would only resort to it when the part bitten could not be extirpated, and when a cautery was not at hand. Yet it must be confessed, that from the numerous attestations to its [260]
efficacy we should be almost led to suppose a very strong affinity to exist between the venom and the animal thus applied.

That so numerous a catalogue of plants have gained credit with the uninformed as specifics, will not be surprising, when we know that the reservoir of the venom is very readily exhausted and slowly replenished. When this reservoir is vacated, the reptile is of course innoxious, and the most inert plant would then stand a good chance of gaining reputation with the credulous as a specific.

For a similar reason we have so many cures for the bite of a rabid animal; and it may be for a similar reason that the body of an animal has acquired repute as an antidote, against the venom of a serpent.

Coluber trivittata of Mr. R. p. 80, of this work. Judging from the descriptive name and the locality, is the *C. sirtalis* of authors, or possibly the *C. saurita* or *C. ordinatus*. These serpents have each the three vittæ, though in the two former this trait is much more striking. I know of no other serpent in our vicinity to which the name can be characteristically applied. The *ordinatus* has been called *bipunctatus* and *ibibe* by the French school. What is the difference between *sirtalis* and *saurita*? they must be very closely allied, if not synonymous.

Coluber getulus, Lin. This species attains to a more considerable magnitude than authors have stated. I saw a specimen on Cumberland Island, Georgia, at least five feet long. The ground colour, by the direction of light in which I viewed him, was deep glaucous or livid, he was much more robust than *C. Constrictor*.[36] He permitted my near approach, without agitating his tail in the menacing manner of the serpent just mentioned, and of the crotali, or manifesting any signs of fear. In my anxiety to secure him, he eluded my grasp, and by a sudden and rapid exertion, [261]
disappeared, with all the rapidity of movement so remarkable in the *constrictor*. This last, from his celerity, is known in many districts by the name of *Racer*.

Coluber heterodon. This viperine species, of which Latreille has formed a genus under the name of *Heterodon*, varies considerably in its markings, and like most of our serpents, is not constant in the number of its plates and scales, (126, 48-138, 42-141, 42, &c.) perhaps too much reliance has been placed upon colour, and upon the number of the plates and scales beneath the body, of the Ophidiæ generally. In the form of the anterior termination of the head, the *heterodon* is remarkable, and a good specific character may be obtained from the orbital scales, which are eleven or twelve in number; the parabolic curve which passes through the eyes, and terminates at the maxillary angles, is also generally present. This same serpent was figured in Deterville's ed. of Buffon, under the name of *Coleuvre cannelee*. The *heterodon* abounds in many sandy situations, and near the sea-shore. Several persons pursuing a pathway, passed within a few inches of one of them without his betraying any emotion, but the moment he perceived me advancing with my eye fixed upon him, he with a sudden exertion assumed a defensive attitude, by elevating the anterior portion of his body, flattening his head, and 3 or 4 inches length of his neck; these he waved with a steady and oblique motion from side to side, uttering at the same time an audible sibilation, he made no attempt to escape, and seemed absolutely fearless until taken. They have the habit of the vipera, but not the fangs. It seems to be synonymous with *Coluber simus*. This species is often called *mockeson*. Dr. Shaw's description of *Boa contortrix* seems to indicate this species. Was he deceived by an erroneous reference to Catesby's figure of this Hog-nose? or by Forster's catalogue?

Coluber punctatus. A good diagnostic character of this species, in addition to the cervical cestus, rests in the triple series of abdominal dots; but these are often wanting or obsolete in the young specimen, in which state it is probably the *torquatus* of Shaw. Sometimes the dots are [262] wanting on the neck and near the cloaca; and in one aged individual, the intermediate line occurred double, and confluent on the throat.

Coluber fulvius, this species is said by Daudin to be closely allied to his *C. coccineus*, notwithstanding the difference in plates and scales. But it is certainly very distinct by other characters, and strikingly so in its perfectly annular black and red bands; the latter are margined with yellowish and spotted with black. A specimen has 224 plates and 32 scales, total length 21 inches, length of the tail $1^{9}/_{10}$ inch. The *coccineus* has the under part of the body whitish, immaculate. The *fulvius* seems to belong to the genus *vipera*; it has the fangs, but not the orifice behind the nostril, which communicates with the reservoir of venom, so conspicuous in the *crotali*, &c.

Ophisaurus ventralis. The tail of this snake not only breaks in pieces when struck with a weapon, but portions of it are thrown off at the will of the serpent. This singular fact I witnessed in Georgia. This is one of the many which are called horn-snakes. A tip of the tail of one of them was once brought to me as having been taken from a recently withered tree, which the bearer assured me was destroyed by the insertion of this formidable instrument, and it was not without considerable difficulty he was convinced of the innocence of the tail, and of having been the dupe of a knave. There seems to be a peculiar character in the mode of imbrication of the scales of this species, each one of these at the lateral edges, passes beneath the lateral scale on one side, and over the edge of the opposite one. It has been described under five different generic names, and four different specific ones.

The *Crotali* do not gain a single joint only to the rattle annually, as is generally supposed. They gain more than one each year, the exact number being probably regulated in a great measure by the quantity of nourishment the animal has received. Rattle-snakes in Peale's Museum have been observed to produce 3 or 4 in a year, and to lose as many from the extremity during the same time. Hence it is obvious, that the growth of these curious appendages is irregular, and that the [263]
age of an individual cannot be determined from their number. Mr. Rubens Peale informed me, that a female of *Crotalus horridus*, Beauv. *durissus*, Daud. which lived in his Museum more than fourteen years, had eleven joints to her rattle when first in his possession; that several joints were acquired and lost annually, and that at her death, which occurred last year, she had the same number as when brought to the Museum; she had, however, during that time received an accession of four inches to her length. Her death was occasioned by an abortion.

The *C. adamanteus*, Beauvois. *Rhombifer*, Daud. is by much the largest of our North American serpents, and doubtless is the species which Catesby saw a specimen of, eight feet long.

Crotalus miliarius varies in some characters from those laid down by authors. A specimen within my view has five dorsal series, of alternate, irregularly orbicular black spots, those of the intermediate series are obsolete, and slightly connected across the back, those of the vertebral series have not red centres, and are edged with a white line; the ventral spots are disposed adventitiously, so as not to be traced into longitudinal series; they are large, black, irregularly orbicular, and occupy about one half of the surface, which is white. Ventral plates 140; subcaudal, 33, of which the six terminal ones are bifid. Joints of the rattle with but one transverse contraction on the middle of each, besides the terminal contraction. Total length 1 foot 4¼ inches, tail two inches. It appears to be more vindictive than the two species before mentioned. The individual here noticed we encountered in East Florida; he struck at Mr. W. Maclure and myself successively as we passed by him, without any previous intimation of his presence, owing to the inaudible smallness of his rattle, and its having but three joints; he was killed by Mr. T. Peale, (whom we preceded) while preparing for another assault. This incident is noted as a contrast to the anecdote of the *Coluber heterodon*.

Salamandra alleganiensis, Daud. appears to be synonymous with *S. gigantea* of Dr. Barton. It
was first described by Mr. Latreille in Deterv. Ed. of Buffon, tom. 11. The name *alleganiensis*, [264]
although defective, as it indicates no character, has however the unalienable right of priority.

Salamandra subviolacea, Barton. This name has been rejected by Mr. Daudin, and substituted by that of *venenosa*, I do not know for what reason, as none is assigned.

Salamandra punctata, Gmel. This appellation was originally given and restricted to the *stelio* of Catesby. tab. 10. (represented in the bill of Ardea Herodias) and was adopted by many subsequent authors, but was finally rejected by Daudin, who considered the species the same as Barton's *subviolacea*. He concurred with Mr. Latreille in appropriating the name thus rejected to *var. β* of *Lacerta*, *aquatica* of Gmel. Notwithstanding this high authority I cannot but coincide with Professor Barton in this instance, in believing it altogether distinct. The single character of the subocellate spots, though not remarked by this author, is a sufficiently discriminative one; these ocellæ are always present, and in no one of the varieties I have seen has the approximation to the *subviolacea* been so considerable as to render a specific discrepance equivocal. Catesby's variety with the ocellæ on the tail seems to be the least common; in general these spots, or epupillate ocellæ, are exclusively confined to a line on each side of the back, about six in each, extending from the base of the head to the origin of the tail, though there are sometimes scattered smaller ones on each side of the body, and upon the vertex of the head, they are of a beautiful reddish colour, enclosed by a definite black areola; the upper part of the body is brownish, with numerous, distant black points, and a slight vertebral, obtuse carina, the inferior surface of the body of a fine yellow or orange, with distant black points, the tail[37] is compressed, ancipital, attenuated to an obtuse tip, longer than the body, and punctured with black in like manner. The younger specimens vary considerably, in being, on many parts of the body, destitute of black punctures, and in having the dorsal and ventral colour, of the same pale [265] orange. It is decidedly aquatic. Several specimens are preserved in the collection of the Academy of Natural Sciences, and from these it is evident that the reddish colour of the subocellate spots is destroyed by the action of the antiseptic liquid; to this circumstance it is probably owing that these spots have been hitherto described as white.

After stating these differential traits, it may be proper to observe, that the *S. maculata* of Shaw is synonymous with the above. But I think it most proper to restore Gmelin's name *punctata*, which will afford an opportunity to do justice to the memory of Laurenti, by reviving the original name by which he distinguished the *Var. β. of Lacerta*, *aquatica*, Gmel., that of *parisinus*.

Bufo cornuta. This animal, which has been stigmatized as the most prodigiously deformed *creature* known to exist!! is generally supposed to inhabit North America as well as Surinam. I do not think it has ever been found in North America. Shaw, in Nodder's Nat. Misc. says it is principally found in Virginia, but in his General Zoology, I think he says that Seba was in error when he represented its native country to be North America. Two other species of *Bufo* have been correctly stated to inhabit this country, viz. *B. musicus*, and *Crapaud rougeâtre*, Daud. (B. rubidus) first noticed as distinct by Mr. William Bartram. I discovered a third species on the banks of St. John's river, East Florida, which, as I am not at present prepared to describe, I shall not surreptitiously name.

It is, I conceive, an incumbent duty on the describer of a natural object, to deposit his specimen, or a duplicate, when practicable, in some cabinet or museum, to which he should refer, in order that subsequent writers may be satisfied with the accuracy of his observations, by examining for themselves. By such reference, and by the re-examination of the same objects by others, the plethoric redundance of synonyma, that prolific source of accumulating error, will be banished or elucidated, and naturalists will most readily arrive at the knowledge of truth, which is, or ought to be, the grand leading object of their labours.

PHYSICS AND CHEMISTRY. [266]

Art. XI. *Outline of a Theory of Meteors.*

By Wm. G. Reynolds, M.D. *Middletown Point, New-Jersey.*

Should the progress of science, for a century to come, keep pace with its rapid advancement for the last fifty years, many appearances in the physical world, now enveloped in obscurity, will then admit of as easy solution as the combustion of inflammable substances, or any familiar process in chemistry does at this day. Among the many subjects from which the veil of mystery would thus be raised, we may include those luminous appearances, in the aerial regions, called meteors, which I am about to consider in the following essay; and which seem to constitute a distinct class of bodies of considerable variety.

Meteors were regarded by the ancients as the sure prognostics of great and awful events in the moral and physical world; and were divided by them into several species, receiving names characteristic of the various forms and appearances they assumed; but of their opinions, as to the physical cause of these phenomena, the ancients have left us nothing solid or instructive. The moderns, more enlightened, have ceased to regard these bodies with the superstitious awe of former ages; but in respect to the cause thereof, are perhaps but little in advance of their predecessors, having, I believe, produced nothing yet that will bear the test of philosophical investigation.

Doctor Blagden (Philosophical Transactions, 1784,) considers electricity as the general cause of these phenomena; Doctor Gregory, and others, think they depend upon collections of highly inflammable matter, as phosphorus, phosphorated hydrogen, &c. being volatilized and congregated in the upper regions of the air. Doctor Halley ascribes them to a fortuitous [267] concourse of atoms, which the earth meets in her annual track through the ecliptic; and Sir John Pringle seems to regard them as bodies of a celestial character, revolving round centres, and intended by the Creator for wise and beneficent purposes, perhaps to our atmosphere, to free it of noxious qualities, or supply such as are salutary. Many other theories, as ingenious as fanciful, might be enumerated; but without commenting on their comparative merit, I must acknowledge that none of them have yet impressed my mind with a conviction of their truth. A series of observations, however, have enabled the moderns to ascertain, with apparent accuracy, several particulars relative to these stupendous bodies, which add much to our knowledge of their general character:—their velocity, equal to 30, and even 40 miles in a second of time; their altitude, from 20 to 100 miles; and their diameter, in some instances, more than a mile, are facts we derive from respectable authority, and may aid us, essentially, in forming just conceptions of their nature and properties.

I believe meteoric stones to result from all meteoric explosions; limiting, however, the term meteor to those phenomena, in the higher regions of the air, denominated fire-balls, shooting-stars, &c. That these bodies move in a resisting medium, must be evident to every attentive observer; and that this medium is our atmosphere, is pretty certain, 1st. Because we know of no other resisting medium round the earth; 2dly. Because the same kind of resistance is apparent at every intermediate altitude, from their greatest to their least, which last we know to be far within our atmospheric bounds; and, 3dly. Calculation has, in no instance, assigned them an elevation beyond the probable height of the atmosphere.

That meteors proceed from the earth, that they arise from certain combinations of its elements with heat, and that meteoric stones are the necessary result of the decompositions of these combinations, are opinions I will endeavour to support, by the following considerations.

1st. The properties and habitudes of matter, under certain conditions and combinations.

2dly. The situation of the earth's surface in respect to the sun, the influence of his rays thereon, [268] and the nature of the elements or compounds on which these rays act:

And 3dly. The identity that exists between the component parts of meteoric stones, and the elements that enter abundantly into the composition of our globe; and, by several other facts and arguments.

Under my first general specification, I will select such principles from the established doctrines of philosophy, as have an immediate bearing on the subject; without engaging in any of those subtle speculations in which certain recondite properties of matter, or the identities of quality and body are affirmed or denied.

Thus, 1st. Heat is the universal cause of fluidity and volatility in bodies; hence no solid can assume the state of gas, until it absorbs, or unites with, a certain portion of caloric; and the subtilty and volatility of compounds thus formed, will be in a due ratio to the quantity of caloric they employ.

2dly. The heat employed to maintain a body in the gaseous state, is said to be latent or fixed, and may be regarded as an ocean or atmosphere of fire, holding the ultimate particles of the body in a state of extreme division, and wide separation, from which they can be driven only by some change in the affinities or condition of the compound.

3dly. If the latent heat in a gaseous compound be suddenly abstracted, as in explosion, its escape is attended with the emission of light and sensible heat, when the volatilized particles held in solution being no longer able to maintain the state of gas, suffer approximation in a due proportion to the quantity of caloric they have lost.

4thly. Caloric, in reducing solids to the state of gas, lessens, but cannot in any case, as far as we know, totally destroy their gravitating force; the diminution of this force, however, being in a direct proportion to the quantity of heat employed.—Hence the following inferences may be fairly drawn, as they seem to be in unison with the relative dependence and harmony existing between the material elements of this globe, and, I believe, are contradicted by no direct experiments; viz. that the expansion of volume, specific levity, and subtilty of artificial gases, are in a direct [269]
proportion to the absolute quantity of caloric they employ; and the caloric is in the same proportion to the insolubility of the substance with which it unites.

5thly. When the specific gravity of bodies on the surface of the earth, is reduced below that of the superincumbent atmosphere, they ascend to media of their own density, in obedience to the laws of Aerostatics; thus we raise balloons by filling them with light air, and the carbon of pit coal and common wood exposed to combustion, and water to the sun's rays, will rise until they reach a medium of like specific gravity with themselves.

6thly. Mechanical agitation and division assist the solution of solids, by bringing fresh portions of the menstruum into successive contact with their fragments, and thus exposing a larger surface.

Under the second head I proceed to notice the situation of the earth's surface in respect to the sun, &c. The atmosphere is a thin, elastic, gravitating fluid, that completely envelopes the earth, to which it may be considered a kind of appendage or external covering; its base resting on the earth's surface, is of an uniform density, growing rare as it recedes therefrom, in a due ratio to the diminution of its gravitating force, until it is lost in empty space. The atmosphere is estimated on certain data to be about 44 or 45 miles high, but we have good reasons to believe it fills a much wider circle, though too thin to reflect the rays of light above its reputed height.

The earth presents one whole hemisphere to the sun in unerring daily succession; and those parts of it which have the least protection against his rays, will, cæteris paribus, suffer the greatest intensity of their action. Within the tropics, the atmosphere opposes less resistance to the sun's rays than in the temperate zones; and in both large tracts of cultivated land, the summits and sides of great ranges of mountains, margin of oceans, rivers, &c. present an almost naked surface to their influence.[38] The exterior strata of the earth, and especially the more [270]
exposed parts thereof, envelope in their compounds, elements of an identity of character with those composing meteoric stones.

The atmosphere is the great recipient of all volatilized bodies; it possesses but feebly the powers of a solvent, unaided by heat or moisture, but when these are adjuvants, no body in nature can totally resist their action for a long time.

Now if the above principles are admitted, we have in their application a reasonable solution of most meteoric phenomena. Thus, the rays of the sun darting through the atmosphere reach the surface of the earth, where, by accumulation, they produce sensible heat, which though not intense, is steady and uniform, for many hours every day; minute portions of the earthy and metallic compounds exposed to the sun's influence, will be volatilized by the absorption of heat, and thereby assuming the state of elastic fluids, will ascend until they arrive at media of their own density. The atmosphere in contact, will have some of its particles blended in these compounds, will ascend with them, and to supply the vacuum, new portions of air will rush in and ascend, and the process will continue until the sun's rays are withdrawn, or interrupted by some of the common occurrences of nature.

The utmost height to which these elastic fluids ascend, may be estimated at something more than one hundred miles; and they float at every intermediate distance between their greatest elevation and the clouds, but rarely below the latter, except their course is directed towards the earth in their explosions. They probably ascend at first in small daily detached portions of gaseous clouds, and are diffused over wide regions; but having no sensible resistance opposed to their mutual attraction, they will by the laws of their affinities congregate into immense volumes of highly concentrated elastic fluids, which on exploding will exhibit all the phenomena of bursting meteors in the following manner, viz. the latent heat on escaping will manifest itself in [271]
the form of fire and light, the force with which it strikes the atmosphere, or the rebound of the latter to fill the vacuum, or both, will occasion sound more or less detonating or hissing, as the escape is more sudden, or the atmosphere more dense; the earthy and metallic particles on the escape of caloric, will obey the laws of cohesive attraction, clash together, recover their gravity, and descend to the earth in masses, or shattered fragments.

Meteoric stones frequently bear the marks of violence, which is doubtless owing to the conflict sustained at the moment of explosion; their difference in size depends on the difference of magnitude in the disploding volumes; something like regular arrangement is frequently perceived in the structure of these stones, because in all productions of solid from fluid matter, the consolidating particles possess a tendency to arrange themselves in the order of their affinities. It is thus the various arrangements in saline crystallization, the freezing of water, and cooling of melted metals, may be accounted for. There is a real, as well as an apparent difference in the velocity of meteoric bodies; the first arising from their difference of magnitude and the violence of the explosion, as well as from the resistance they meet; the latter, from the different distances at which they are seen. The gradation of colour, from a bright silvery hue to a dusky red, is owing, in a certain degree, to the state of the atmosphere refracting different coloured rays, and also to the materials in the compound, similar to the different hues in artificial fireworks. Reddish and white nebicula are sometimes left in the tracks of meteors, which are nothing but ignited vapours, or the particles brushed off the burning body by the resisting atmosphere. The velocity or motion and direction of meteors, depend upon principles well known and daily practised by engineers, and the constructors of fireworks.

The immediate cause of these explosions is a little obscure, and merits a fuller detail than is compatible with my present limits; their analogy to the electric phenomena in the clouds, leaves room to suppose they are effected by certain modifications of electricity. Clouds of opposite [272]
electricities will approach each other and explode, by the positive imparting as much electrical fire to the negative cloud as will make them equal, when just as much water as the imparted fire held in solution, will be set at liberty and descend to the earth. If, however, this solution be deemed inapplicable, perhaps the following may be admitted. Thus, when heat is urged upon incombustible[39] bodies with a force that overcomes the cohesive property by which their particles are tied together, it unites with them in large quantities, and becomes latent, by which union they are reduced to the state of elastic fluids; and as it is a universal property of heat to counteract the gravitating force of bodies, these compounds must necessarily become volant, and ascend as above stated. It is only thermometrical or sensible heat, that destroys the attraction of cohesion existing between the particles of bodies, the repulsive power of latent heat being barely able to counteract this property, when the elements under its dominion are removed beyond a certain distance from each other; now the very reduced temperature in the high regions to which these gaseous clouds will ascend, may admit their earthy and metallic particles within the sphere of cohesive or aggregative attraction, when the caloric will be expelled like water from a sponge, accompanied by all the phenomena above stated.

The third general head of my subject leads me to inquire into the constituent principles of meteoric stones: sundry papers on the analysis of these productions, have been furnished us by chemists of acknowledged reputation and ability, and in none of these that I have seen, was there any element described that had not been previously known. But should it hereafter be found that air stones contain matters not found on our globe, the fact will afford no absolute proof of the foreign origin of these stones, as we are successively discovering earthy and metallic principles of distinct characters from those already known.

A portion of one of these stones that fell in the town of Weston, (Connecticut) examined by the [273]
late Dr. Woodhouse, gave the following results in a hundred parts, viz.

Silex	50	
Iron	27	
Sulphur	7	
Magnesia	10	
Nickel	1	inferred from chemical tests.
Loss	5	
	——	
	100	

"The sulphur was seen by the naked eye distributed through the silex in round globules the size of a pin's head, after dissolving the powdered stone in diluted nitric acid."

All specimens of these stones do not afford precisely similar results, but differ in their constituent elements and relative proportions; their component parts, however, are to be found abundantly in schist, schorl, pyrites, pebble, granite, &c. on which the sun must daily act.

The following facts go to strengthen the above theory, viz. Meteors are most frequent and stupendous in tropical countries, where the heat of the sun is most intense; and less frequent in our climate in the winter and spring, while, and after the earth has been covered with snow for many weeks in succession; and they are most frequent in the higher latitudes towards autumn, after a continuation of hot dry weather: out of the whole number (179) of shooting stars I have noted during the last twelve years, 149 appeared between June and December, inclusive.

If it be said that the specific gravity of meteoric stones being several times that of water, it is absurd to suppose they can rise, (if even reduced to the state of gas) to the elevated stations here assigned them, seeing the vapours of water can ascend only one or two miles above the earth. To this I reply, that the doctrine of heat is not yet so thoroughly understood, as to acquaint us with all its habitudes with natural bodies, but we infer from analogy, that the more refractory a body is in the fire, the greater in a due ratio is the absolute quantity of heat required to reduce it to, [274]
and retain it in, the state of gas, and the greater, in a corresponding degree, will be the dilatation of its particles and decrease of its specific gravity. Hence, if water reduced to vapour by heat, be capable of assuming an altitude of two miles, it follows that more refractory substances reduced to a similar state, will suffer expansion and fugacity in a due proportion to the quantity of caloric they employ, and will assume a corresponding elevation, as already inferred under my first head.

Another objection may be, that though high degrees of heat affect certain solids as above stated, yet these cannot be sensibly acted on by such feeble agents as atmospheric air and the rays of the sun. I answer, if it be admitted that sensible heat acts on solids in an increasing ratio to its intensity, it follows that lower degrees, though acting in an inverse ratio to higher, must affect the same bodies in a conceivable degree at any temperature above their natural zero:[40] and though the heat of the sun beating on a plane surface for several hours is feeble, compared with that produced by a burning lens, or air furnace, yet if it be sufficient to detach from one square foot of the earth's surface the 104023 part of a grain in twenty-four hours, the quantity taken from 100 square miles, in the same time and proportion, would amount to ten pounds, which is abundantly sufficient for all meteoric phenomena; and the loss to each square foot, supposing the process to be uninterrupted, would be no more than one grain in 284 years. When we advert to the intense heat produced by concentrating a few of the sun's rays in a burning lens, the whole quantity daily sent to the earth must strike us forcibly. If collected in a lens of [275] sufficient magnitude, they might volatilize a space equal to the state of New-York in a moment of time! As all bodies possess a limited capacity for heat, does it not follow that there must be some outlet to its perpetual accession to our globe, or the earth would soon become so highly ignited as to glow with the fulgour of a meteor? And may not this outlet be found in the above described compounds? which serve as conductors of the surplus of heat from the earth to the higher regions of the air, where on being freed by displosion, from the grosser matters incumbering it, it finds a rapid passage to its great archetype and parent, the SUN. Thus his daily waste may be restored, and an equilibrium, by the return of his own emanated particles, preserved, between the sun and the earth, and probably all the planets of our system.

The last consideration I shall offer in favour of the domestic or earthly origin of meteoric phenomena, is the difficulties that present to our granting them a foreign one. Though I am well aware of the respectability of the names which the theory of moonstones can summon to its support, yet I have always regarded it as unfounded and unphilosophical for the following reasons, viz. 1st. Whether the moon has an atmosphere or not, we will all admit that she has attraction, which must extend to many thousands of miles from her surface. No projectile force that we are acquainted with can throw a heavy body 100 miles, even though no atmospheric, or other resistance than its own gravity, were present; hence the idea of that force extending to thousands of miles from the moon's surface, is gratuitous and nugatory. 2dly. The products of volcanoes bear no similarity of origin, or kindred resemblance to meteoric stones; those are lavas of different kinds, pumicestone, scoria, ashes, &c. these solid masses of matter, with some degree of regularity in the arrangement of their constituent particles. 3dly. The descent of these stones has no coincidence in point of time with the position of the moon. She is as often in their nadir as their zenith. We also witness in all cases, explosion and light in our own atmosphere, at the time of the descent of these stones. This could not be the case if they proceeded from the moon, for obvious reasons. 4thly. The heat adequate to such projectile force as would carry a [276] body from the moon's surface beyond the sphere of her attraction, would volatilize the matter of meteoric stones in a moment; hence they would not be projected from the Lunarian crater in solid masses, but in elastic vapour.

In conclusion, although the theory which I have endeavoured to elucidate and establish, be subject to some difficulties and objections which science may hereafter remove, it appears to me perfectly consonant with the relative dependence and harmony of our system, and by no means at variance with the infinite wisdom and power by which it was originated.

ART. XII. *Observations upon the prevailing Currents of Air in the State of Ohio and the Regions of the West, by* CALEB ATWATER, *Esq. of Circleville, Ohio; in Letters addressed to His Excellency De Witt Clinton, LL. D. Governor of the State of New-York, and President of the Literary and Philosophical Society.*

(Communicated for the American Journal of Science, &c.)

Circleville, Ohio, July 23, 1818.

DEAR SIR,

With pleasure, I acknowledge the receipt of the circular letter bearing date the 5th instant, which you addressed to me, for which you will be pleased to accept my warmest acknowledgments for yourself personally, and the Philosophical Society of which you are the president. To answer all the questions which are put to me in that letter, is not at present within my limited means, either as it respects the leisure or the ability. I shall therefore, at this time, confine myself to "observations upon the prevailing currents of air in the state of Ohio."[41] These observations will be wholly founded on personal experience, during the four years in which I have traversed this state, from Lake Erie to the Ohio river, whilst attending on the several courts, in [277] all seasons and in all the changes of weather.

The prevailing currents of air, one of which generally obtains in Ohio, are three.

The first comes from the Mexican Gulf, ascending the Mississippi and its larger tributary branches quite to their very sources.

The second proceeds from the back of mountains to the west, descends the Missouri to its mouth, and then spreads over a vast extent of country.

The third comes down the great northern and northwestern lakes to the south end of Lake Michigan and the southern shore of Lake Erie, where it spreads over the region of country lying to the south of them.

That current of air which comes from the Mexican Gulf, is warmer, and perhaps more moist, than any other which prevails here. After a few days prevalence, it uniformly brings rain along with it. That this current of air should be very warm may be readily conceived, when we reflect that it comes from a hot tropical region; and that it should be very moist, excites no surprise, when it is considered, that in its passage upwards it passes wholly over water, and through the warm mists and fogs constantly ascending from the Mississippi and its tributaries. This current prevails much more along the Ohio river than it does at any considerable distance from it. One consequence is, that the climate in the immediate vicinity of the Ohio river is warmer, than it is either north or south of it, unless you go to the southward a considerable distance. Other causes may, and probably do, in a greater or less degree, contribute to produce this result, and I will here state them:

First, The Ohio runs on a surface less elevated above the sea than the country, either north or south of it, but this difference is trifling through the whole of the sandstone formation. This formation prevails from the head of the Ohio to Aberdeen, which is opposite to Marysville in Kentucky, at least two-thirds of the distance which that river washes the southern shore of this state. The reason is obvious, because there are no falls in a sandstone formation.

Another cause which contributes to produce a warmer climate, especially in the winter season, [278]
in the valley of the Ohio, is, that several considerable streams which empty themselves into the Ohio, have their sources on the highlands, a great distance to the south of it; for instance, the Great and Little Sandy, and the Great and Little Kenhawa, which descending from a warm region of country, their waters contribute to keep the Ohio open in winter.

But these causes are by no means sufficient to produce the one half of the comparative warmth of climate observable in the immediate vicinity of this invaluable river. To prove that the climate is much milder in the southern than in the northern part of this state, I will proceed to mention several facts, which have fallen under my own observation.

In the latter part of last February I was at the town of Delaware, on the Whetstone Branch of the Scioto river, between eighty and ninety miles south of Lake Erie, and twenty-five miles north of Columbus, the seat of government, which is near the centre of the state, where I saw a number of gentlemen direct from Detroit, by the way of Lower Sandusky, who informed me that the snow at that time was eighteen inches in depth and upwards all along the lake shore, but gradually decreased as they came south until they arrived at Delaware. At that place it was then about twelve inches deep in the open fields, and somewhat deeper in the woods. I descended the road along the Whetstone to Columbus, the snow decreasing in depth all the way as I proceeded. At Columbus it wholly disappeared in the fields, and only ice was found in the road, which also decreased until I came to the Big Walnut Creek, thirteen miles south of Columbus, where it disappeared, and the road began to be muddy. As I still proceeded south, the mud increased in depth until I came to Chillicothe, about thirty-two miles south of Big Walnut, where the frost was entirely out of the ground, and the roads were almost impassable. As I still descended southward, along the Scioto, I found that at Piketon, on the Scioto, nineteen miles south of Chillicothe, the road had considerably improved. I proceeded onwards to Portsmouth on the Ohio river, at the [279]
mouth of the Scioto, about twenty-six miles south of Piketon, where the ground was entirely settled, and the innkeeper, where I lodged, was making his garden, sowing his sallad seed, and planting his peas. This journey was performed in three days, and in travelling only one hundred and fifteen miles from north to south, this extraordinary difference of climate was observed.

A traveller may leave Portsmouth when the farmer is beginning to hoe his corn the first time, and travel with good speed to Delaware, and find the husbandman just beginning to plant.

Instances which have fallen within my own personal observation might be multiplied to a great extent, but a few may suffice.

Generally speaking, there is a difference in the beginning and ending of the warm season of about two weeks between Portsmouth and Delaware, or of three weeks between the former place and Lower Sandusky.

In relation to the warmth of the climate, I will state two other facts, originating, as I believe, in the prevalence of the southern current of air from the Mexican Gulf along the Ohio river.

First, In the summer months the paroquet ascends the Scioto more than one hundred miles from its mouth, and until within a few years past, wintered at Miller's Bottom, and at other places along the banks of the Ohio, near its great southern bend in latitude 38° north, in Gallia and Lawrence counties, in the state of Ohio. I have seen them there in all the winter months in considerable numbers, but few however now winter there; and probably if the cold northwestern current of air from the great lakes becomes more and more prevalent in the winter months, these birds will migrate altogether to a more southern clime.

Are these birds found as far to the north on the east side of the Alleghany by at least three degrees? Monsieur Volney, Mr. Jefferson, and others, say not. It has been denied that this fact proves any thing more than that this bird frequented these parts in quest of its favourite food. This food is grass and other vegetable matter in summer, and the cockle bur, and the balls of [280]
button-wood, or, as by a perversion of language, it is called in this country sycamore.[42] But this bird may find its favourite food as well east as west of the Alleghanies. The grasses and trees alluded to, flourish as I have observed in forty-five degrees of north latitude, and I am credibly informed that they are abundant as far north as Quebec, and even around Hudson's Bay. Wherever waters run and trees grow on their banks, (if low and wet,) on the American continent, even as high as eighty degrees of north latitude, there the paroquet may find its food in abundance.

Another fact tending to establish the same point is, that the reed cane, before this country was much settled, grew in a higher latitude by several degrees on this than it did on the other side of the Alleghany mountains. It has indeed been said, that this cane was never found north of the

Ohio, nor above the mouth of the Big Sandy River, which empties into the Ohio, on the line which separates Virginia and Kentucky. This however is incorrect; for within a few years it was growing in abundance at Miller's Bottom, twenty-six miles above the mouth of Big Sandy. It grew at Lancaster, on the Hockhocking, northward of the mouth of the Big Sandy, in a direct line, at least one hundred and fifty miles, and it now grows on the Whetstone branch of the Scioto, more than two degrees of latitude above the lowest bend of the Ohio, which is at the mouth of the Big Sandy. Before the white people settled there, I have every reason to believe, that the cane grew in great plenty at Delaware, where there are more signs of buffaloes than at any other place within my knowledge. It has been conjectured, that the seed of the cane was brought down and scattered by the Big Sandy; but granting this, in what way could that stream carry this seed up the Hockhocking and Scioto to their sources? to places several hundred feet above the highest freshes ever known in this country? With a knowledge of these facts, cast your eye at the map of Ohio. Proofs within my reach might be multiplied to a much greater extent, but they are probably [281]
unnecessary.

But another current of air prevails here, especially in the cold months, coming from the mouth of the Missouri, which is a little to the south of west of this place. This current is colder than the preceding one, and though moist, yet not as much so as the one already described. It prevails generally in October and November, before our warm weather is over, and produces frosts and a chilly dampness, and what I have observed nowhere else, especially on the east side of the Alleghanies, it produces a kind of faintness at the breast.

People of delicate habits, coming here from the northern and eastern states, uniformly complain of this faintness. It is not perhaps extraordinary that this current of air should be cold, proceeding as it does from a high northern latitude, along the great chain of rocky mountains in the northwest; that it should be moist, and perhaps also that it should affect the animal economy unpleasantly, may possibly be attributed to its passing such a length of way over the waters of the Missouri, and the wet prairies and barrens lying so extensively between us and the head waters of that stream. The luxuriant vegetation which covers these prairies and barrens at that season of the year, begins to putrefy, and fills with unhealthy exhalations every gale of wind which passes over them.

At the mouth of this river (Missouri,) which is in about latitude 38° north, this current of air is extremely cold in the winter months. It diverges from this point, and produces extreme cold at a considerable distance to the south of it on the Mississippi river. General Rector, the present surveyor general of the United States, who keeps his office at St. Louis, informs, that he has known the Mississippi at St. Genevieve, in latitude about 37°, so firmly covered with ice in one night, as to be able to bear horses and cattle the ensuing day. This circumstance must have been owing to the sudden change of the current of air from south to the northwest, descending the Missouri river from the cold regions at its sources.

From several gentlemen, residents for many years in Illinois and Missouri Territories, I have [282]
been informed, that changes of weather in that region of country are, especially in winter, very frequent and great; that one day the moist south wind from the Mexican gulf will prevail, and produce quite warm and mild weather for the season; on the very next, or frequently in the latter part of the same, the current of air from the sources of the Missouri will prevail, and block up the streams with ice.

There is a third current of air which prevails during our winter months, more and more, annually, as the country becomes cleared of its forests in the direction alluded to; it proceeds from the great lakes to the northwest of us, and even beyond them. Proceeding as it does from the north and northwest of lake Superior, and crossing the great expanse of water in this direction, it rushes down these great lakes to the south end of lake Michigan in latitude about 41° north, diverges from that point, and spreads over the immense regions lying to the south, where the air is more rarefied by reason of its warmer climate. This current of air brings along with it intense cold, and extended last winter even to New-Orleans, where the snow fell to such a depth, that sleighs were seen passing in every part of the city. The more the forests are cleared away between any place in this country and the northern lakes, the more this cold current of air will prevail. This current also diverges from the southern shore of Lake Erie, but is not so strong as that part of it which diverges from the south end of Michigan, and of course does not extend as far to the south. When this part of this state was first settled, this current of air was hardly felt at this place, and then only for a short time in the winter months, and hardly ever reached the Ohio river; but last winter it continued three weeks at one time, and produced good sleighing; and also caused rheumatisms, pleurisies, peripneumonies, &c. which proved mortal to some. In this place, which is in latitude about 39° 20′ north, the thermometer of Fahrenheit, hanging in an entry of a dwelling-house with closed doors, sunk to 24 degrees below zero. This extreme cold may be attributed to general, rather than to local causes, and it may be said that the winters all [283]
over the world have been colder of late years than formerly. But on the very day, when it was thus cold, (if newspapers can be believed) a great number of vessels put to sea from Reedy Island in the Delaware below Philadelphia, and about thirty sail of vessels went to sea from New-York harbour.

All our streams were at the same time bridged with ice of great firmness as well as thickness, and continued to be so for a considerable time afterward, until the warmer current of air from the south prevailed over the current from the lakes. It will be proper, and may be necessary, here to state, that the latitudes of several places in this country are very different from what you would be led to believe from examining any map or chart now or ever in existence. For instance, Lake Michigan extends farther south than Fort Wayne, which place by actual survey is in this state; St. Louis is not 38°, and the most southern point or bend of the Ohio river, is not more than latitude 38° north. I state merely what I am informed of by those who have ascertained these facts by actual observation and survey. The place opposite the mouth of the Big Sandy, is nearly as for south as Lexington in Kentucky. The south end of Michigan lake ought to be laid down on the map 41° north. Prevailing currents of air (not every breath of air which moves over the surface) I have attempted to describe. It may be well enough, however, to mention some other currents which sometimes prevail for a few days. And here I will mention what our oldest settlers along the Ohio have observed, that is, that whenever in a dry time, there is a current of air proceeding down the river for three or four days in succession, the current from the Gulf of Mexico is sure to drive it back with redoubled force, and after blowing a day or two, it is equally sure to bring rain with it. It is easy to assign a cause for it; for meeting the trade winds in the Gulf, it is driven back with redoubled violence to the sources of the larger streams which empty themselves into the Gulf.

When a thunder storm, proceeding in either a western or eastern direction, as the case may be, happens to strike a large water-course running either north or south, and when also there [284] happens to be a large branch emptying into the stream, within a few miles either above or below the point where the storm approaches it, I have uniformly observed the storm to cross the large stream at the point where the large branch unites with it, and ascend the branch. Where there are two large tributaries about equi-distant from the point of approach, the storm frequently divides and follows each of them. The reason why it should be so, this is not the place to discuss; but the Wisdom and Goodness which so ordered it, are too apparent to every rational mind to be overlooked. It may be asked if the difference in latitude and elevation between the Ohio and lake regions of country, does not produce a great difference in the climates of those respective regions? These causes certainly produce some difference, but not all. It is my object to establish facts, rather than any favourite theory. The difference of latitude between the Ohio river at the mouth of the Scioto, and lake Erie at the mouth of the Maume or Sandusky, is nearly three degrees, and the difference of elevation above the sea is trifling, if any. From the mouth of the Scioto to Columbus, about 90 miles in a direct line, the water, where there is what is commonly called a *ripple*, runs briskly, and these ripples happen, perhaps, one to a mile; but they are in a sandstone region, and the fall of course is trifling.

Let us suppose then, that the river Scioto descends one hundred feet from the mouth of the Whetstone, which empties into that river at Columbus, to the Ohio, and that the Whetstone which runs through a limestone formation, descends another hundred feet, which would make Upper Sandusky two hundred feet higher than the Ohio river. From this highest ground between the Ohio and the lake, it is a well-known fact, that the land descends towards the north much more in a given distance, than it does towards the south, and the distance is not half as far. The Maume and other streams putting into the lake, are full of rapids. Admitting for argument's sake, that the Sandusky or Maume descend only 100 feet, then the surface of the lake is 100 feet higher than the Ohio river. Would three degrees of latitude, and 100 feet greater elevation produce three [285] weeks difference in the seasons? Is there that difference between Baltimore in Maryland, and Wilkesbarre in Pennsylvania? Is there that difference between New-York and Fort Edward on the Hudson? It is believed that there is not one half that difference.

I have referred but little to thermometers, because they are kept in so many different situations by their owners, that I have known no less than 8 degrees of difference between several of them kept in one town, within almost a stone's throw of each other, at one and the same moment of time.

Every allowance being made for other causes, I am still of the opinion that the difference in the climates of the Ohio and lake regions of country, is to be attributed chiefly to the prevalence of different currents of air. The southern current rarely, if ever, reaches the northern lakes, and the northern, until lately, never reached the Gulf of Mexico. But as the country is cleared of its native forests, we may reasonably conclude this cold current of air will prevail more and more, until we shall have snow enough for sleighs, at least two months in every winter; the summers will be shorter, the extremes of heat and cold will be greater than at present, and those clouds which formerly obscured the sun almost continually during the summer months, will be chased away, and with them the pale cheek, the sallow hue, the oppression at the breast, and the difficulty of respiration, the headache, and the thousand ills which many of the first emigrants have experienced in our climate. We shall probably then have fewer diseases, and more acute ones. The storms will probably be fewer, more severe, and not continue as long as at present. There are still further views which might be taken of this subject, but they are left to abler pens and future observations.

Thus I have endeavoured to give my opinion on a subject of some interest to the present, as well as future generations; in doing which, I have not sought for flowers which might have been gathered by stepping out of my path, but the *fruit* rather of my own observation and experience: I have not wandered through the fields of imagination, invoking the poetic muse, but addressed [286] myself chiefly

"To him who soars on golden wing,
Guiding his fiery-wheeled throne,
The cherub contemplation."

ART. XIII. *On a singular Disruption of the Ground, apparently by Frost, in Letters from* EDWARD

HITCHCOCK, A.M. *Principal of Deerfield Academy.*

(With a Plate.)

To the Editor of the American Journal of Science, &c.

SIR,

I have lately examined a singular disruption in the earth, discovered a few days since in the northerly part of an extensive meadow in this town, about ten rods from Deerfield river.

The soil on the spot is alluvial, consisting of a dry, rich, vegetable mould, with a large intermixture of sand; and the field, elevated 14 feet above the bed of the river, is annually mowed. A valley encircles the ruptured spot on the east, south, and west, only five feet lower, yet so marshy and soft, as to render draining necessary to make it passable; and immediately back of this valley, on the south, rises a hill 100 feet high, at whose foot are several springs. North of the rupture, also, between it and the river, is a gradual descent of three feet: indeed, the ground slopes from it on every side except the northwest.

A fissure one inch wide and fourteen deep, forming an almost perfect ellipsis, whose diameters are 9 and 5½ rods, marks the exterior limit of the convulsion. Within this curve are several others nearly concentric to it, some forming a quarter, and some half an ellipsis, and near the longer axis are others, running in various directions. On this transverse diameter, which lies near the [287]
highest part of the swell above described, and in its longest direction, or parallel to the river, the greatest effect of the convulsion appears. The earth, to the depth it has frozen the past winter, 14 inches, is broken on a straight line above 6 rods, and the south edge of the fissure, having been forced up, overlaps the other, three feet. Where one edge does not thus overreach, the tables of earth, which at a small distance resemble masses of ice, are raised up so that their faces form an isosceles triangle, leaving a cavity beneath. About the extremities of the transverse axis, is also an overlapping of two feet, which continues nearly two rods on the curve each way from the axis, and in most places is double, overreaching internally and externally, exhibiting likewise, some irregularity where the compressing forces acted at right angles to each other. The edges of these elevated masses of earth, which are yet frozen, are quite smooth, and the angles but little fractured. I have dug into the earth about four feet underneath the longer axis of the ellipsis, and thrust down a bar in other places, but cannot perceive that the soil has been moved below where it was frozen. It is, however, not the most favourable season for ascertaining this fact.

Every appearance on the spot will justify this conclusion, that the frozen surface of the earth around, has pressed with great force *from every direction* to this ellipsis as a centre; for, were every fissure in the ellipsis to be filled by replacing the earth, there must remain on its longer axis and at the extremities of this, an overplus of surface two feet wide.

The month of February last has been unusually cold. Its mean temperature in Deerfield, by Fahrenheit's scales, is as follows.

7*h.* A. M.	1½*h.* P. M.	10*h.* P. M.
6°	24°	11°

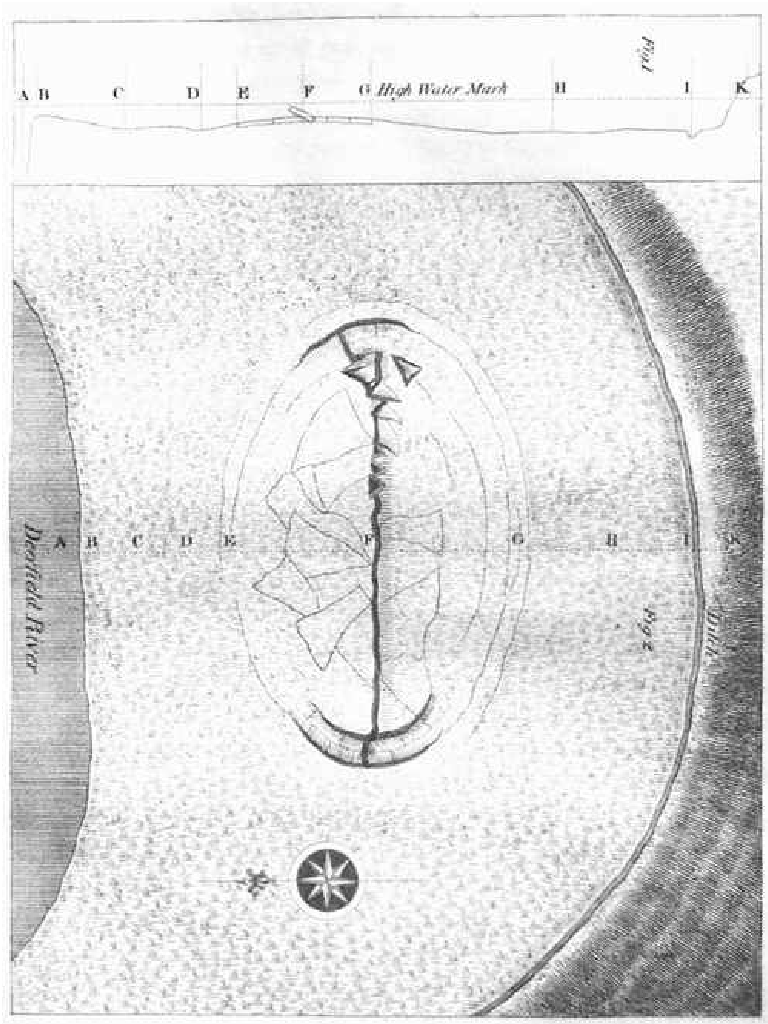
The extremes were 25° below, and 49° above zero. On the last day but one of the month, the cold suddenly relaxed; and on the 1st and 2d of March, a heavy and warm rain succeeded. This produced an uncommon rise in Deerfield river, and on the 3d of March, it had overflowed the [288]
ground where the above described phenomenon occurred, and did not recede from it for 24 hours. Its greatest depth there, was five feet. The snow was nearly one foot deep when the flood happened, and being a nonconductor of heat, the temperature of the surface of the ground was not probably much changed from its state in February, until the water came in contact with it. It may not be amiss to give the state of the thermometer on the last of February and beginning of March.

	7*h.* A. M.		1½*h.* P. M.		10*h.* P. M.		Wind, weather, &c.	
Feb. 27th,	15°	below 0.	28°	above 0.	32°	above 0.	South,	clear.
28th,	31	above	45	——	31	——	do.	do.
March 1st,	29	——	46	——	37	——	N. E.	rain.
2d,	46	——	49	——	37	——	do.	do.
3d,	30	——	35	——	29	——	do.	rain & clear.

On the third of March, about sunset, some lads were sailing near the spot where the disruption appears, and saw the water in considerable agitation, with much bubbling, and at short intervals it was thrown up in several places to the height of 3 or 4 feet. They saw no rupture in the earth, although they came within two or three rods of the spot, and state the water to have been two feet deep. About one o'clock on the morning of March 4th, Mr. Seth Sheldon and family, living one mile south from this spot, and being awake, were alarmed by a loud report from the north, by which their house and furniture were much shaken. They compared the sound, though louder by far than they had ever heard from this cause, to that of a cracking in the earth by frost in severe weather. Some others living rather nearer the spot, were awakened by the same report. That the rupture in the earth was made at that time is probable, though not certain.

It may be proper to state, that during the flood, no ice, except a few loose masses, was carried over, or near the spot where the disruption appears. This, therefore, could not have produced it.

Disruption of the Ground by Frost.



N. & S. S. Jocelyn Sc. N.H.

Fig. 1. is a transverse section, taken with a theodolite, from Deerfield river 28 rods south, crossing the longer axis of the disruption at right angles. The scale is 4 rods to an inch, although [289] in laying off the heights and levels, the exact proportion was a little varied, to render the irregularities of surface more distinct. The letters of reference correspond to those on fig. 2, and need no explanation.

Fig. 2. is a bird's-eye view of the disruption and the adjoining region, very obligingly sketched by Mr. Derick Barnard of Troy, New-York. The surrounding country is somewhat contracted to bring more of it into view.

These are all the facts I am able at present to collect concerning this phenomenon. I have been particular as to the temperature of the air, and the situation of the adjacent country, from an idea that frost was a principal agent in producing it; and that, therefore, these circumstances would be important in fixing a theory. I will not, however, hazard any hypothesis on the subject; but if you deem the fact of sufficient importance, your opinion, Sir, is respectfully solicited.

Your humble Servant,

EDWARD HITCHCOCK.

Deerfield, Mass. March 26th, 1818.

Deerfield, June 3d, 1818.

Sir,

Since I sent you a description of a singular disruption in the earth in this town, another has been observed in the same meadows, about one mile from the former. This is less than the one of which I sent you an account, but its situation is almost exactly similar; it being on a small elevation, on the sides of which, at a few rods distant, is low wet ground. Indeed, the *general* description which I sent you will answer for this smaller disruption. The diameters of this last, are only 7 and 8 paces, and the curve is not perfect. There appears to have been an expansion of the earth's surface around both these spots, or disruptions, by which it was forced to give way at the point where there was the least resistance, which, of course, would be on the highest ground. The more I observe of this phenomenon, the more I am inclined to impute it to the agency of frost.

It may be proper to observe, that in neither of these disruptions has the general mass of the hills sunk in the least. Had this been the case, it might perhaps have accounted for them. It is also certain, that the soil below where it was frozen the past winter, has not been moved. I mentioned this fact in my first communication, though with some suggested doubt. [290]

REMARKS.

An opinion having been requested by Mr. Hitchcock on the above facts, it may be observed, that there appears in the statement sufficient evidence that the phenomenon (as the author has suggested) is attributable to frost.

It is a fact, established equally by common experience and by numerous experiments, that water, in freezing, expands. It is generally estimated that 8 cubic inches of water, become 9 by the act of congealing. The expansion is attributed, with sufficient evidence, to a crystalline arrangement arising from a kind of polarity in the particles of water exerted when they are near congealing, by which they attract one another in certain points, and not in others. Dr. Black, with his usual felicity, has illustrated this tendency, by supposing a great number of small magnetized needles, thrust through corks, so that they will float parallel to the surface of water, to be thrown promiscuously into a vessel of that fluid. They will not remain in the situation in which they are thrown in, but, in consequence of their polarity, attractions and repulsions will be immediately exerted; they will rush together, with a force equal to the overcoming of a certain resistance; they will arrange themselves in pairs and groups, and finally, in a connected assemblage.

The particles of water attract each other with a prodigious force, when resistance is opposed; for it is well known that domestic utensils, trees, rocks, and even cannon, and bomb-shells, are burst with explosion, when water confined within them is frozen.

There is force enough then exerted by the expansion of freezing water, to produce all the mechanical violence, whose effects were so striking in the instance at Deerfield.

In the common cracking of the ground by frost, so extensively observed in cold climates, the effect appears to result in the following manner. The water contained in the ground, (that is, in [291] that part which is within the reach of a freezing temperature) by congealing, expands and demands more space; a movement must necessarily take place in the direction where there is the least resistance; this will evidently be upward, because the atmosphere, the only counteracting power in this direction, cannot resist the expansion of the freezing water as much as it is resisted by the earth below the freezing stratum. Consequently, the freezing earth is forced upward, but being of unequal strength in different places, it cracks at the weakest spot; and the earth, for some distance on the sides of the fissure, is thrown into the position of two planes gently inclined, their relative position resembling that of a very flat roof, and the more they are lifted by frost, the more they will decline from one another, and the wider will be the fissure.

But why, in the instance which Mr. Hitchcock has related, did they overlap? The explanation appears to result from the circumstances of the case, as far as they can be understood without ocular inspection of the ground.

The elevated spot which cracked in so remarkable a manner, being nearly surrounded by a *belt* of low wet ground, the congelation of the water in this ground by the intense cold, would of course produce a very great expansive effort towards the elevated ground. This, not only on account of its elevation, but from its containing less water, would not be able to exert an equal counteracting effort. The surface of the ground, therefore, (without at all disturbing the unfrozen earth below,) was, by the expansive effort of the freezing water, *pushed along* towards the elevated spot. This spot being possessed of a certain power of resistance derived from its gravity, and from the freezing of the water in it, would not immediately give way; but the whole surface, it is probable, gradually rose for some time, while the expansion was going on and increasing. A cavity would thus be produced between that superficial layer of frozen ground which was rising, and the unfrozen ground below. This cavity would of course be filled with air derived from the atmosphere, and from the porousness of the ground below. When the place came to be overflowed, water would immediately rush in through any fissure, and this hydraulic and [292] hydrostatic effort would force the air out at any orifice, and thus blow the water up with it. This was probably the cause of the agitation of the water, and of the bubbling of air, and of the throwing up of the water at intervals, observed by the boys on the 3d of March.

The effect of the water covering the ground, would be to weaken its cohesion derived from frost, and as there were probably hundreds of tons of pressure, the vaulted ground, when sufficiently weakened, gave way with a loud explosion and a violent concussion, as heard by Mr. Sheldon's family, a few hours after the facts observed by the boys. The parts of the arch now fallen in, (so to speak) necessarily either overlapped, or rose in ridges, piece being pressed against piece, as described and figured by Mr. Hitchcock.

We are indebted to this gentleman for his delineation of this singular case.

The freezing of water, and its attendant expansion, are productive of multiplied and very diversified phenomena upon our globe, whether we contemplate them in the delicate spiculæ of hoarfrost, the six-rayed stars of snow, or in the stupendous glaciers of the Alps, and the awful icebergs of Greenland.

Cambridge, January 25, 1819.

PROFESSOR SILLIMAN.

Dear Sir,

If the following observations are worthy of a place in your valuable Journal, please to insert them, and oblige yours, with real esteem,

J. F. DANA.

ART. XIV. *On a New Form of the Electrical Battery, by* J. F. DANA, M. D. *Chemical Assistant in Harvard University, and Lecturer on Chemistry and Pharmacy in Dartmouth College*.

The Electrical Battery in its common form is an unmanageable and inconvenient apparatus.
When the coated surface is comparatively small, the instrument occupies a large space, and it [293]
cannot be readily removed from place to place without much trouble and risk; the apparatus is, moreover, very expensive, and when one of the jars is broken, another of the same dimensions cannot readily be found to supply its place.

It occurred to me, that a Battery might be constructed of plates of glass and sheets of tinfoil, in which the same extent of coated surface should occupy a much smaller space, and consequently that the apparatus would be more convenient and more portable. I selected several panes of glass, the surfaces of which coincided closely with each other, and then arranged them with sheets of tinfoil in this order, viz. pane of glass, sheet of tinfoil, then another pane of glass, then a second sheet of tinfoil, and so on; the sheets of foil being smaller than the plates of glass by two inches all around; the glass being 10 by 12, and the foil 6 by 8. This apparatus contained six plates of tinfoil, and the lowest plate being numbered *one*, was connected with the ground, and by slips of tinfoil passing over the edges, with the *third* plate, and this, in like manner with the *fifth*. The *second* plate was connected with the *fourth*, and this with the *sixth*, which communicated with the conductor of the machine; in this manner each plate positively electrified will be opposed by one negatively electrified, and vice versa; the 6th, 4th, and 2d plates positive, and the 5th, 3d, and 1st, negative. Into this apparatus I could introduce a powerful charge, but not possessing a battery of the common form, could not make comparative experiments. The annexed figures will explain the construction of this apparatus.

(See Plate.)

Dr. J. F. Dana's Electrical Battery.

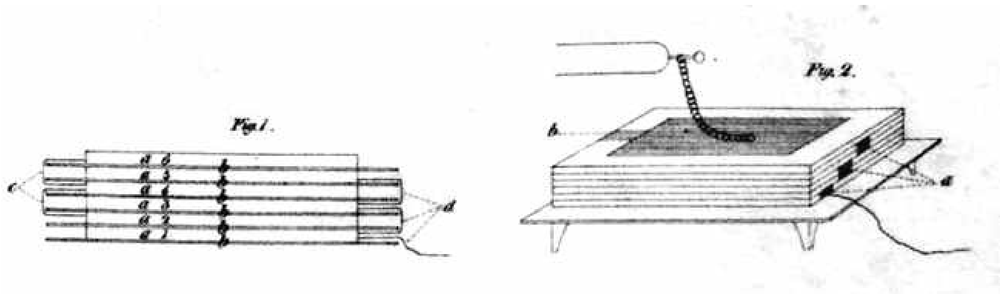


Fig. 1. *a* 1, *a* 2, &c. the tinfoil.

b b b, plates of glass.

c, the intermediate slips connecting the plates 6, 4, and 2.

d, the slips connecting 5, 3, 1, and the ground.

Fig. 2. *a*, the intermediate slips passing over the edges of the glass and connecting plates, 1, 3, and 5.

b, the slip which connects the upper sheet of foil with the 4th, &c.

In a battery of the ordinary form, it is evident that a much less surface is coated than in one of
the above construction; in a battery of the common form, two feet long, one foot wide, and ten [294]
inches high, and containing 18 coated jars, there will be no more than 3500 square inches of coated surface, while in a battery of the same dimensions on the proposed construction, there will be no less than 8000 square inches covered with tinfoil, allowing the sheet of glass and of foil to be ¼ inch thick.

When plate glass is employed for making this battery, the ring of glass exterior to the tinfoil may be covered with varnish, and then the next plate laid over it; the tinfoil will then be shut out for ever from the access of moisture, and the insulation will remain perfect. This form of the Electrical Battery is very portable, may be packed in a case with the machine, and indeed a powerful battery occupies no greater space than a quarto volume. It is cheap and easily constructed.

ART. XV. *Chemical Examination of the Berries of the Myrica Cerifera, or Wax Myrtle, by* J. F. DANA, M. D. *Chemical Assistant in Harvard University, and Lecturer on Chemistry and Pharmacy in Dartmouth College*.

(Communicated for this Journal.)

The myrtle wax of commerce has been examined by Dr. Bostock and by M. Cadet; the entire berry not having been made the subject of analysis, I have been induced to examine it, with a view to ascertain the proportion of wax.

I. Fifty grains of the most perfect berries were digested in repeated portions of warm alcohol, until the fluid appeared to exert no further action. The first portions of alcohol were tinged of a green colour, but the last portions remained colourless.

II. The alcoholic solutions were poured into a small retort of known weight; the alcohol was carefully distilled off, and the residuum dried; deducting the weight of the retort, there remained 18.5 grs. for the weight of the matter dissolved by the alcohol.

III. The substances which had been dissolved by the alcohol consisted of two portions, viz. the [295]
wax, which was of an apple-green colour, and a reddish brown substance; this substance was supposed to be resinous, and the contents of the retort were therefore digested in acetic acid; the acid soon became of a reddish brown colour, and dissolved nearly the whole of the matter in the retort, leaving the wax. The acid solution, together with a small portion of insoluble reddish matter, were carefully separated from the wax. The wax being dried and melted, weighed 16 grains.

IV. The acetic acid solution was evaporated to dryness, and a dark brown matter was obtained; it was almost totally soluble in warm alcohol, from which it was precipitated by water; it was supposed therefore to consist chiefly of resin, with a small portion of extractive matter, and may be called resino-extractive; it weighed 2.5 grains.

V. The matter insoluble in alcohol consisted of two parts, viz. the kernels and a fine-grained black powder, having very much the appearance of fine gunpowder; the powder was carefully separated from the kernels by a wire sieve, and weighed 7.5 grains. The kernels were found to weigh 23.75 grains.

From this analysis it appears that the entire berries consist of

Wax	32.00
Resino-extractive	5.00
Black powder	15.00
Kernels	47.00
	———
	99.50
Loss	.50
	———
	100.00

The chemical properties of the wax and of the black powder may be made the subject of another communication.

Earthy phosphate of iron has recently been found at Hopkinton, Mass. It exists there in large [296]
quantities, and is employed as a pigment. The gentleman on whose grounds it was found sent me several pounds of it.

J. F. D.

Art. XVI. *Analysis of Wacke, by Dr.* J. W. Webster, *of Boston.*

One hundred parts exposed to a red heat in a platina crucible lost 18.5, acquired an umber brown colour, and a degree of hardness sufficient to scratch glass.

One hundred parts reduced to fine powder were mixed with four times the weight of soda, and exposed to heat, gradually increased for three quarters of an hour; at the expiration of which time, the whole had acquired a pasty consistence. The crucible was now removed from the fire, its outer surface carefully wiped. Muriatic acid was poured on till all effervescence ceased. The solution obtained was evaporated to dryness, gradually assuming an orange red colour. Water was now poured upon the mass, after which it was filtered, and the powder remaining carefully dried; after ignition, and while warm, it weighed 28 parts. This powder was insoluble in muriatic acid, and of a white colour.

To the filtered solution, reduced by evaporation, carbonate of potash was added, the precipitate was collected on a filter, washed and dried; it weighed 23 parts. This powder was redissolved in sulphuric acid, sulphate of potash added, and crystals of alum finally obtained; hence this powder was alumine. To the liquor from which the silex and alumine had thus been separated, acetic acid was added; the whole evaporated to dryness; the excess of acid being removed, a small quantity of water was poured on, and after strong ignition, the precipitate weighed 4.5.

Into a very small tubulated retort I introduced a portion from the same mass, whence the piece
submitted to analysis was broken, and obtained over mercury the carbonic acid in the usual [297]
manner. This was equal to 2.32; by deducting this from 18.5 the loss during exposure to red heat,

we shall have 16.18, the proportion of water. The oxide of iron was separated from the solutions after the addition of acetic acid, by ammonia, and weighed 26 parts.

Silex	28.
Alumine	23.
Lime	4.5
Carbonic acid	2.32
Water	16.18
Oxide of iron	26.
	——
	100

AGRICULTURE AND ECONOMICS.

Art. XVII. *On the Comparative Quantity of Nutritious Matter which may be obtained from an Acre of Land when cultivated with Potatoes or Wheat, by Dr.* Eli Ives, *Professor of Materia Medica and Botany in Yale College*.

In a good season an acre of suitable land well cultivated will produce 400 bushels of potatoes. In Woodbridge, a town adjoining New-Haven, a crop of 600 bushels of potatoes has been obtained from a single acre. A bushel of potatoes weighs 56 pounds. Multiply 400, the number of bushels, by 56, the weight of a single bushel, gives 22400, the number of pounds of potatoes produced upon one acre.

Thirty bushels of wheat are considered a good crop as the product of one acre of land. About ⅚ of wheat may be considered as nutritious matter.

According to the experiments of Dr. Pearson and Einhoff, about one-third of the potato is nutritious matter. From the analysis of Einhoff, 7680 parts of potatoes afforded 1153 parts of [298] starch—fibrous matter analogous to starch 540 parts—albumen 107 parts—mucilage 312 parts. The sum of these products amounts to about one-third of the potatoes subject to the experiment.

Sir Humphry Davy observes, that one-fourth of the weight of potatoes at least may be considered nutritious matter.

One-fourth of 22400, the product of an acre of ground, cultivated with potatoes, is 5600. The whole weight of a crop of wheat calculated at 30 bushels to the acre, and at 60 pounds to the bushel, gives 1800. Deducting one-sixth from the wheat as matter not nutritious, and the weight is reduced to 1500.

The nutritious matter of the crop of potatoes to that of wheat is as 5600 to 1500, or as 56 to 15.

The starch might be obtained by a very simple machine, recommended by Parmentier; and in seasons when potatoes are abundant, the potatoes might be converted to starch, and the starch preserved for any length of time, and used as a substitute for wheaten flour.

The machine alluded to is a cylinder of wood about three feet long and six inches in diameter, covered with sheet tin, punched outward so as to form a coarse grater, and turned by a crank. This cylinder is placed in a box of boards whose sides slope a little inward upon the principle of a hopper, and a tub of water is placed beneath: The potatoes are thrown into this box, and as the crank is turned they are crushed, and the starch or fecula subsides to the bottom of the water. It is well known, that potatoes are largely used in England mixed with flour to form a very good bread; the *starch* of the potato would of course answer much better.

ART. XVIII. *Biographical Notice of the late* ARCHIBALD BRUCE, M. D. *Professor of Materia Medica, and Mineralogy in the Medical Institution of the State of New-York, and Queen's College, New-Jersey; and Member of various Learned Societies in America and Europe.* With a Portrait.

(Communicated.)

Doctor Archibald Bruce, (the subject of this Memoir) was a native of the city of New-York, in North America. He was born in the month of February, in the year seventeen hundred and seventy-seven. His father was, at that time, at the head of the medical department of the British army, (then stationed at New-York) to which he had been attached from his youth, having been many years previously resident at New-York, as surgeon to the artillery department; where he was married, in or about the year seventeen hundred and sixty-seven, to Judith, a daughter of Nicholas Bayard, formerly of the same city, at that time the widow of Jeremiah Van Rensselaer of Greenbush; by whom he had another son, (who died an officer in the British army in Ireland) and a daughter, who died while a child.

William Bruce, (the father above-mentioned,) and his brother Archibald, together with a sister, were natives of the town of Dumfries in Scotland, where their father was many years resident as the parochial clergyman; and so continued until his decease, much respected.

Both sons applied themselves to the science of medicine and surgery. William, as above stated, became a physician in the British army, and died, in that station, of the yellow fever, in the island of Barbadoes. And Archibald received a commission of surgeon in the British navy, in which he continued until disqualified by old age, when he retired from business, and died a few years since [300] in London. For many years he acted as surgeon to the several ships commanded by Sir Peter Parker, captain, and afterward admiral.

Doctor William Bruce, before his final separation from his family, on the occasion of his being ordered to the West-India station, had always declared that his son Archibald should never be educated for the medical profession; and finally enjoined such instruction upon his wife and friends, to whom the charge of the boy was committed. After his decease, the same injunction was repeated by the uncle, then in Europe, who was ever averse to his nephew's making choice of this profession: much pains were therefore early exerted to divert him from such inclination.

The momentous state of political affairs, induced his mother to send him to Halifax, under the care of William Almon, M. D. a particular friend of her husband, with whom, however, remaining but a short time, he returned to New-York; and was placed at a boarding-school at Flatbush, Long Island, under the direction of Peter Wilson, LL.D. who was in high standing as a teacher of the languages.

ARCHIBALD BRUCE M. D.

In 1791, he was admitted a student of the arts in Columbia college. Nicholas Romayne, M.D. was at this time among the physicians of highest consideration in New-York, and was engaged in delivering lectures on different subjects of medical science in Columbia College. Having pursued the early part of his medical studies with Dr. William Bruce, he felt a generous gratitude for the instruction and attention which he had received from him, and endeavoured to requite them by advising with his son, and promoting his views, as far as lay in his power. Here commenced a friendship which increased with advancing years, and terminated but with life. At this period, young Bruce began to evince a desire to oppose the inclination of his father and friends by studying medicine; this study, without their knowledge, and while a student of the arts in the senior class, he commenced by attending Dr. Romayne's lectures. Such was the strong bent of his mind towards the study of medicine, and its collateral physical pursuits, that the persuasion and [301] remonstrances of his friends proved alike ineffectual, and he soon gave free scope to the prevailing inclination.

The collection and examination of minerals, a pursuit not then at all attended to in this country, was his particular relief from other studies; for even during his recreation, he was ever on the look-out for something new or instructing in mineralogy.

Dr. Romayne being about visiting Europe, young Bruce pursued his studies with Samuel Bard, M.D.; and having attended the usual courses in Columbia College, he left the United States for Europe in 1798, and in 1800 he obtained the degree of doctor in medicine from the University of Edinburgh, after defending a Thesis, De Variola Vaccina.

Having now finished his medical studies, he was prepared to visit the continent of Europe with peculiar advantage; for his continued attachment to mineralogy, a liberal distribution of American specimens then comparatively new in Europe, and his social habits and dispositions, which were very conciliating, secured him the best introductions from Edinburgh, and laid the foundation of permanent friendships.

During a tour of two years, he visited France, Switzerland, and Italy; and collected a mineralogical cabinet of great value and extent. After his return to England, he married in London, and came out to New-York in the autumn of 1803, to enter on the active duties of a practitioner of medicine.

Previous to the year 1805, the practice of physic in the state of New-York was regulated by no public authority, and of course was not in the happiest condition to promote the respectability and usefulness of the profession. To remove, as far as possible, the existing inconveniences, Dr. Bruce became an active agent, and in conjunction with Dr. Romayne and other medical gentlemen of New-York, succeeded in establishing the state and county medical societies, under the sanction of the state legislature. This act "may be considered among the first efforts made in this country to reduce medicine to a regular science, by investing the privileges of medical men in the body of the members of the profession."

In the organization of the College of Physicians and Surgeons of the state of New-York, Dr. Bruce and Dr. Romayne were eminently active, and by their united exertion and perseverance, [302] (opposed by much professional talent) they obtained a charter from the regents. In this new institution, as professor of the materia medica, and of his favourite pursuit, mineralogy, he exhibited the fruits of arduous study, with a dignity of character, and urbanity of manner, which commanded the respect of the profession, and the regard of the students.

The ruling passion in Dr. Bruce's mind, was a love of natural science, and especially of mineralogy. Towards the study of this science, he produced in his own country a strong impulse, and he gave it no small degree of eclat. His cabinet, composed of very select and well characterized specimens; purchased by himself, or collected in his own pedestrian and other tours in Europe, or, in many instances, presented to him by distinguished mineralogists abroad; and both in its extent, and in relation to the then state of this country, very valuable, soon became an object of much attention. That of the late B. D. Perkins, which, at about the same time, had been formed by Mr. Perkins in Europe, and imported by him into this country, was also placed in New-York, and both cabinets (for both were freely shown to the curious, by their liberal and courteous proprietors) contributed more than any causes had ever done before, to excite in the public mind an active interest in the science of mineralogy.[43]

Dr. Bruce, while abroad, had been personally and intimately conversant with the Hon. Mr. Greville, of Paddington Green, near London, a descendant of the noble house of Warwick, the possessor of one of the finest private cabinets in Europe, and a zealous cultivator of mineralogy. Count Bournon, one of those loyal French exiles, who found a home in England, during the storm of the French revolution, was almost domesticated at Mr. Greville's, and was hardly second to any man in mineralogical, and particularly in crystallographical knowledge. His connexions with [303] men of science on the continent, were of the first order, and to be familiar at Mr. Greville's, and with Count Bournon, was to have access to every thing connected with science in England and France. Dr. Bruce was also at home at Sir Joseph Banks's, the common resort of learned and illustrious men. Thus he enjoyed every advantage in England, and when he went to the continent, the abundant means of introduction which he possessed, brought him into contact with the distinguished men of Paris, and of other cities which he visited. The learned and estimable Abbé Haüy was among his personal friends and correspondents; and many others might be mentioned in the same character, whose names are among the first in the ranks of science, in various countries of Europe.

Returned to his own country, after being so long familiar with the fine collections in natural history, and especially in mineralogy, in various countries in Europe, Dr. Bruce manifested a strong desire to aid in bringing to light the neglected mineral treasures of the United States. He soon became a focus of information on these subjects. Specimens were sent to him from many and distant parts of the country, both as donations and for his opinion respecting their nature. In relation to mineralogy he conversed, he corresponded extensively, both with Europe and America; he performed mineralogical tours; he kindly sought out and encouraged the young mineralogists of his own country, and often expressed a wish to see a journal of American mineralogy upon the plan of that of the School of Mines at Paris. This object, it is well known, he accomplished, and in 1810, published the first number of this work. Owing to extraneous causes, it was never carried beyond one volume; but it demonstrated the possibility of sustaining such a work in the United States, and will always be mentioned in the history of American science, as the earliest original purely scientific journal of America.

Dr. Bruce had, in a high degree, the feelings of a man of science. He was ever forward to promote its interests, and both at home and abroad, was considered as one of its most distinguished American friends.

Many strangers of distinction came introduced to him, and his urbanity and hospitality rarely [304] left him without guests at his board. During the latter part of his life, he seems to have been less interested in science. His journal had been so long suspended, that it was considered as virtually relinquished; his health was undermined by repeated attacks of illness, and science and society had to lament his sudden departure, when he had scarcely attained the meridian of life.

He died in his native place on the 22d of February, 1818, of an apoplexy, in the 41st year of his age.

Art. XIX. 1. *Dr.* J. W. Webster's *Lectures*.

Dr. J. W. Webster, some months since, commenced a course of Lectures in the town of Boston, on Geology and Mineralogy. Having finished his first course, he is now occupied with a second on the same subjects, and we understand receives the patronage of some of the most respectable citizens of Boston and its vicinity. He makes Geology the groundwork of his plan, and fills up by describing the metals and minerals met with in each class of rocks, after the rock has been noticed. A pretty full account is given of the coal formations, (several of which Dr. W. has visited) and of the modes of searching and boring. A view is given of the formations of Paris and the Isle of Wight, with specimens from those districts.

In the volcanic part, a description (from personal observation) is given of St. Michael's. The structure of veins; the forming and destroying effects of water; the physiognomy of the dry land and submarine; the origin of islands and coral reefs, and a view of the principal mountain ranges throughout the world conclude the course.

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2. *Dr. Webster's Cabinet.*

Dr. Webster, having spent two or three years in Europe, in professional studies, during which time he devoted much attention to mineralogy and geology, with the ample aids afforded by the cabinets and distinguished teachers in Scotland, France, and England, has recently returned to his own country, and has brought with him a very select and considerably extensive cabinet of minerals, with which, and with American specimens, he illustrates his lectures. We understand that the collection contains some thousand specimens, and is good in the English and Scotch minerals; also in the Siberian coppers; it contains a suite of three hundred geological specimens from Freyberg, from granite to gravel. The geological part is extensive, and was increased by numerous pedestrian tours in England and Scotland; most of the geological specimens have been examined, in company with Professor Jameson. The volcanic part is good, from the extensive opportunities which Dr. Webster enjoyed in the Azores, in which, on his return to this country, he spent some time, and found much to interest him. His observations will soon be given to the public, in a work entitled *Remarks on the Azores or Western Islands*.

It is well known that they are volcanic, and of course afford the usual volcanic substances. The most interesting part is that occupied by the boiling fountains, in many respects similar to the Geysers of Iceland, excepting that the water is not ejected to any considerable height; but the incrustations, the sinter, and sulphur, are every way equal to any specimens which Dr. Webster saw in Sir G. Mackenzie's collection.

We are much gratified in noticing both what Dr. Webster has done and is still doing. We are persuaded that he will do much towards promoting the cultivation of American mineralogy and geology, and especially in the enlightened community in which he resides.

We cordially wish him success, and trust that it will be ensured by the patronage of the citizens of Boston.

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3. *Supposed identity of Copal and Amber.*

A correspondent, whose paper is withheld from publication till some additional experiments can be made, conceives that copal and amber are originally the same substance, and the product of the same tree.

4. The Necronite.—(*A supposed new mineral.*)

Extract of a letter from Dr. H. H. Hayden of Baltimore, to the Editor, dated January 5, 1819.

"It (the necronite) occurs in a primitive marble, or limestone, which is obtained 21 miles from Baltimore, and a small distance from the York and Lancaster road. It was first noticed by myself at Washington's monument, in which this marble is principally employed.

"It occurs, for the most part, in isolated masses in the blocks, or slabs, both in an amorphous and crystallized state. It is most commonly associated with a beautiful brown mica, of the colour of titanium; small but regular crystals of sulphuret of iron, tremolite, and small prismatic crystals of titanium, which are rare. The form of the crystals is a rhomboid, approximating very much to that of the felspar, and which has inclined some to consider it as such. Also, the hexaedral prism, resembling that of the beryl. This form is rare, and has not, as yet, I believe, been found complete. Its colour is a bluish white, and clear white. Its structure much resembles felspar, being lamellar; sometimes opaque, semi-transparent and transparent, at least in moderately thin pieces. It scratches glass, carbonat of lime, and even felspar, in a *slight* degree. In all our efforts, it has been found infusible, per se, or with borate of soda, and even from all the force of heat that could be excited in a smith's furnace, it came out unchanged in any degree. The acids seem to have no sensible effect upon it, either cold or hot. This is all that I can say of it at present, except that it possesses a most *horrid* smell.[44] I have since found in a marble of the same kind, but from a different quarry, and a few miles distant from the first, a quartz almost as fetid as the necronite, and likewise associated with *small* prisms of titanium. [307]

"These substances carry with them a degree of interest in another point of view. They seem to invalidate the opinion that the fetid smell of secondary limestone, slate, &c. is derived from the decomposition of animal matter. As their gangue is *decidedly* a rock of primitive formation."

Another new mineral observed by Dr. Hayden.

"Exclusive of the interest which the necronite has excited with me and several others, I have besides stumbled upon another substance, if possible still more interesting. I discovered it in an imperfect state, about 4 years since, but not until recently have I been able to find it perfect, in beautiful garnet coloured cubic crystals ¼ of an inch square or nearly. These crystals are very liable or subject to decomposition, in which state they present a perfect but spongy cube. Although they resemble the cubic zeolite, yet they have nothing of its character with them besides."

Remark.

Dr. Hayden without doubt alludes to the *chabasie* of the Abbé Haüy, formerly but inaccurately called the cubic zeolite; for it is really a rhomboid very nearly approaching a cube—its angles being 93° 48′, and 86° 12′.

5. Preservation of Dead Bodies.

From Thenard's Chemistry, vol. iii. *Paris ed. p.* 713.

The author declines describing the methods of embalming commonly employed, and proceeds to describe the mode which was for the first time employed by Dr. Chaussier.

"This process consists in placing the dead body thoroughly emptied and washed, in water kept constantly saturated with corrosive sublimate. This salt gradually combines with the flesh, gives it firmness, renders it imputrescible, and incapable of being attacked by insects and worms.

"I have seen, (adds the author) a head thus prepared, which had been exposed alternately to [308] the sun and rain during several years, without having suffered the slightest change. It was very little deformed, and easily recognized, although the flesh had become as hard as wood."

6. Matches kindling without fire.

(*From Thenard's Chemistry, Vol.* ii. *p.* 525.)

This match is prepared by mingling two parts of the oxymuriate of potash and one of sulphur, which by means of a little gum is attached to a common sulphur match. This match on being dipped into, or rather slightly wet with, strong sulphuric acid, (oil of vitriol) immediately catches fire.

The author has not added the caution that the sulphur and salt should be pulverized separately; if rubbed together in a mortar, they will explode with some danger to the operator, provided the quantity be over a few grains.

Matches made upon this principle, have been for some time made and sold in this country. They are sometimes put up in little japanned cases with a small phial, from which when inverted with the mouth open, nothing will drop, and yet the match kindles on being thrust in quite to the bottom. The truth is, these bottles contain a little amianthus moistened with sulphuric acid, which thus kindles the match, but as the acid soon weakens by attracting water from the air, it is better to use a phial of the acid in the liquid state. A few drops answer the purpose, and when this is weakened, it is easily renewed.

7. *Cleaveland's Mineralogy.*

Our opinion of this work was fully expressed in the review of it in our first number. In the Edinburgh Review for September, 1818, this work is again reviewed, and in a manner which must gratify every friend to American science. It will be necessary to cite only a single sentence. After commending the condensed and *honest* manner in which the work is printed, (for they say, that the same matter which here fills one volume would in England have been spread over three,) the reviewer adds, "We should be glad to see it reprinted exactly upon the plan of the original; [309] and we have no doubt that it would be found *the most useful work on mineralogy in our language*." More need not be—more scarcely could be said.

8. *A new Alkali.*

A new alkali has recently been discovered in Sweden, by M. Arfwedson. It is found in the petalite, a mineral from Utoen, in Sweden, in a proportion not over 5 pr. ct.; also in the triphane or spodumene, in the proportion of 8 per cent. and in what is called crystallized lepidolite, in the proportion of 4 per cent. In its general properties it very nearly resembles the other alkalies. When heated in contact with platinum it acts on it. In the galvanic circuit it was decomposed "with bright scintillations, and the reduced metal being separated, afterward burnt." This metal resembles sodium. The new alkali has been called lithia. (*Jour. of Science of the Roy. Inst.*)

9. *Ignited Platinum Wire.*

In our last we mentioned the lamp without flame, the ignition of platinum wire being sustained by means of the vapour of alcohol.

Sir H. Davy has discovered that the vapour of camphor answers the same purpose: "If a piece of camphor, or a few small fragments in a heap, be placed in any convenient situation, as on a shilling, the bottom of a glass, &c. and a piece of platinum wire, either coiled or pressed up together, be heated and laid upon it, the platinum will glow as long as any camphor remains, and will frequently light it up into a flame."

Jour. Roy. Inst.

10. *Red Rain.*

A red rain fell in Naples, (March 14, 1818,) the common people were much alarmed, and called it *blood* or *fire*.

An earthy powder was collected, which when dry was yellow, unctuous, and of an earthy taste; its specific gravity 2.07.

Its analysis presented silex 33—alumine 15.5—chrome 1.— iron 14.5—carbonic acid 9., and a combustible substance of a carbonaceous nature.

It is thought that this powder had not a volcanic origin, and that the presence of chrome [310] assimilates it with meteoric stones. *Ibid.*

11. *Gnephalium.*

Professor Ives has discovered a new species of gnephalium with decurrent leaves, of which a plate and description will appear in our next number.

12. *Augite.*

M. Haüy has united the fassalite and the bakalite with the sahlite, a sub-species of augite. (See Mem. of the Museum of Nat. Hist. vol. 3.)

13. *A New Vegetable Alkali*,

Has been found by Messrs. Pelletier and Caventon in the Feve St. Ignace and the Nux Vomica. It has been named the vaucquelin, in honour of M. Vaucquelin. (Journal de Physique, for Aug. 1818.)

14. *New Minerals.*

Two new mineral species have been discovered, the scorrodite from Schnuburg in Saxony, and the tungstate of lead from Zinnwald in Bohemia. *Ibid.*

15. *New Metal.*

A new metal has been discovered by Berzilius, in the mines of Fahlun in Sweden, to which he has given the name of Selenium. *Ibid.*

16. *Pure Alumine.*

A large bed of this substance, perfectly pure, has been found at Argenton, Department de L'Endre. *Ibid.*

17. *Collections of American Minerals.*

We are informed that under the auspices of Col. Gibbs, a collection of American minerals by states, according to the arrangement of the minerals of the departments of France, in the cabinet of the school of mines at Paris, was begun some time since, at the rooms of the Hist. Society in New-York; and recently in the University of Cambridge. In the arrangement of the latter, he has [311] been assisted by Dr. J. W. Webster, lecturer on mineralogy and geology in Boston.

18. *C. S. Rafinesque, Esq.*

We are requested to announce that a Journal of this gentleman's "Travels and Discoveries in the West, will be published this year by Cramer and Spear of Pittsburg, and that the results of his zoological and botanical labours consist in the discovery of about 15 new genera, and 180 new species of plants; about 75 new genera, and 600 new species of animals, whereof nearly 70 are new fishes, 20 new quadrupeds, 30 new reptiles, 112 new shells, 250 new fossils, &c." "He has inquired how the deep valleys have been excavated, where lakes existed, where the old falls of the Ohio were, the extent and origin of the coal region, &c."

19. *Medical College of Ohio.*

Extract of a letter from Cincinnati, Jan. 10th, 1819.

The legislature of the state of Ohio have just established a medical college in this city, and have by an unanimous vote passed a law incorporating the Faculty. In the act, Dr. Samuel Brown of Alabama is named as Professor of Anatomy, Dr. Daniel Drake of Cincinnati, Professor of the Institutes and Practice of Medicine, Dr. Coleman Rogers, Professor of Surgery, and Dr. Slack, Professor of Chemistry. The other Professors are to be appointed by the Faculty, and it is believed that Dr. Richardson of Lexington, Kentucky, will be called to the Obstetrical chair. Very high expectations are entertained of the importance of this institution in the west.

20. *Notes on Ohio.*

Caleb Atwater, Esq. of Circleville, Ohio, has issued proposals for publishing the above work, (mentioned in our last number) with a prospectus exhibiting its principal features. We doubt not it will contain valuable information concerning a very interesting portion of the United States, and every effort on the part of men of intelligence and enlarged views, to make the western and southwestern states better known, deserves, and it is believed will receive, adequate support.

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21. *Discovery of American Tungsten and Tellurium.*

Neither of these metals, so far as we are informed, has been announced as existing in either of the Americas. It is well known to mineralogists, that tungsten is very rare, and that tellurium is found only in Transylvania.

We have now the pleasure to state that both these metals exist in the Bismuth mine, in the town of Huntington, parish of New Stratford, in Connecticut, 20 miles west of New-Haven.

During the examination of some ores, brought to us by Mr. Ephraim Lane, the proprietor of this mine, we obtained the tungsten in the state of yellow oxid, and the tellurium in the metallic state.

The tungsten is stated to be abundant in the mine; it is the ferruginous species, known to mineralogists by the name of wolfram.

We cannot yet say whether the tellurium is abundant, having obtained it from only two pieces; from these we extracted also tungsten, so that it may possibly constitute a new mineral species. Further particulars will be given in our next Number.

22. *Mr. Sheldon's Application of Chesnut Wood to the Arts of Tanning and Dying.*

REMARKS.

A considerable time since, we were confidentially made acquainted with the discovery detailed in the following letter. We have repeated the most important of Mr. Sheldon's experiments, both in relation to tanning and dying, and are well satisfied that the discoverer has not overrated, or erroneously estimated, the value of his own results. We are persuaded that the highly *useful* arts alluded to, will derive important aid from the use of a material so abundant and cheap as chesnut wood.

To Professor Silliman.

Springfield, Mass. Feb. 27, 1819.

Dear Sir,

I send you a more particular account of the newly discovered properties of the chesnut.

This tree, *Fagus Castanea*, Linn. is very abundant in New-England and the middle states; and occurs in the mountainous districts, as far southward as South-Carolina, or perhaps even Georgia. It is one of the stateliest trees of the forest; scarcely less distinguished by the beauty of its foliage, than by the durability of its wood. [313]

By repeated analyses, conducted with the minutest attention to every circumstance which could ensure accuracy, it appears, incredible as it may seem, that the chesnut *wood* contains twice as much tannin as ross'd[45] *oak bark*, and six-sevenths as much colouring matter (which gives a black with iron,) as logwood. I am aware that nothing could be farther from the common apprehension than such results; but the uniform success of a great variety of experiments in tanning and dying, in addition to the other kind of evidence, should satisfy the most incredulous.

The leather tanned with it, has, in every instance, been superior to that tanned in a comparative experiment, with oak bark; being firmer, less porous, and at the same time more pliable. The reason for this difference, will probably be found in the *high state of oxygenizement* of the bark, particularly of the epidermis, by which it is rendered to a certain degree acrid and corrosive. Dr. Bancroft was perhaps the first who noticed the oxygenizement of barks. He attributes the dark brown colour of the epidermis of *his* quercitron, to this cause; and as a confirmation of the idea, I have observed that ink made of the epidermis of another kind of bark, though at first not to be distinguished by the colour from that made of the cellular and cortical parts, is incomparably less permanent.

As a material for making ink, the wood of the chesnut is probably unrivalled. Combined with iron in any proportion, it gives, as it is dilute or concentrated, a pure blue or blue-black; while galls, sumach, &c. &c. unless combined with a greater proportion than is consistent with the highest degree of permanency, afford a *black* more or less inclining to a reddish brown. The lake [314] of the chesnut is indeed a blue, and not to be distinguished by the eye from indigo; but when diffused on paper, this same substance becomes an intense shining black. In dying, little difference is observable between the chesnut and galls, and sumach, except that the former has a rather greater affinity for wool, &c. than the latter, and of course requires less boiling. Its permanency has been completely tested by long exposure to the sun and the weather; but no doubt can exist on this head, if the position of Berthollet be true, that permanent blacks are formed only by the combination of iron and tannin.

To prepare the chesnut wood for the purposes of tanning, a mode has been devised for reducing it to a suitable degree of fineness. This method consists in the application of knives, either in the direction of, or transversely to the grain, by a rotatory motion. This mode obviously involves the greatest possible economy of moving power. Messrs. B. and M. Stebbins, of West-Springfield, who are making arrangements for going largely into the exportation of the article, have in construction a machine upon this plan.

As might be expected, the inspissated aqueous extract of the chesnut, bears a near resemblance in many particulars, to catechu. Professor Dewey, of William's College, who at my request, has gone through an extensive and elaborate course of experiments, informed me that he obtained a quarter more of the gelatinous precipitate from the former, than from the latter. By the taste, the two substances are not to be distinguished, except that the former is more pungent. It leaves upon the tongue, the same permanent and refreshing sweetness, for which the other is so much prized in the east; where it is used as an article of luxury, with betel nut. Might not the extract be advantageously substituted for catechu, in the celebrated life preserving composition of Dr. Pearson; the object being to concentrate the greatest possible quantity of nutritious and tonic substances in the smallest weight.

The colouring properties of the two substances, are entirely different. After the discovery, twelve or fifteen years since, of the composition of the *terra japonica*, attempts were made in England to introduce it into the materia tingentia, as a substitute for galls; but unfortunately, like [315] the extract of quercitron, it affords with iron nothing but a meagre olive; and Dr. Bancroft states, that in a great number of trials, he was unable, by the greatest accumulation, to produce any thing like a black, even upon wool, much less upon cotton and silk.

A singular fact, which I observed in the course of my experiments, is worthy of notice. I had prepared for a certain purpose, solutions from the wood of the trunk of a tree, about three feet, and from that of a limb about three inches in diameter. The same quantity of wood and of the solvent was employed in both cases. On adding to each the same quantity of the solution of gelatine, abundant precipitates immediately appeared, as usual, apparently much the same in quantity; but to my astonishment, the size of the several congeries in each, bore a near proportion to that of the sticks from which they were obtained, not differing much from that of middling and of very small flakes of snow. Is not this an extraordinary fact, evincive of a complication in the arrangement of these bodies hitherto unsuspected. May it not at some future period, lead to a *nomenclature of precipitates*; affording, like the crystallography of Haüy, a new and accurate mode of determining the compositions of substances; and perhaps throwing light upon the obscure subject of chemical, or if you please, electro-chemical affinities. The *size* of a stick might probably be ascertained with almost as much precision, as by actual admeasurement. The solutions in this experiment, were formed by maceration in cold water. When hot water was employed, and the process was completed in two or three hours, the appearance of the precipitate was very different, the congeries being smaller, irregular, and not well defined.

I have only to add, that having taken measures to secure the discovery, both in this country and Europe, it is my wish to bring it into general use as speedily as possible.

I am, Sir, very respectfully,
Your obedient servant,
WILLIAM SHELDON.

P. S. In a short article for some future number, I may send you an account of the operation of the machine, and of some other particulars.

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23. *Additional note concerning the Tungsten and Tellurium.*

We have not room to insert in the present number, a description and a chemical examination of the ores of tungsten and tellurium recently discovered in Connecticut; they will appear in our next.

In the mean time it may be stated, that the tungsten and tellurium are found blended in the same pieces, but whether in mere mixture, or in chemical combination, is not yet quite determined. Many specimens of the tungsten exist without the tellurium, but every piece which has afforded tellurium has also afforded tungsten, and in greater abundance. Even in well defined crystals, both metals have been found in the same crystal, and where the external appearance was homogeneous. In other specimens a difference seems to be apparent, and a proper ore of tellurium appears to be blended with a proper ore of tungsten. This latter ore is the wolfram, composed of oxid of tungsten, or as some choose to say, tungstic oxid combined with iron and manganese. The crystals, however, are octahedral, a fact which we believe is not mentioned of this species by authors, although this form is found in the calcareous tungsten.

The Bismuth mine in which these ores are found is the property of Mr. Ephraim Lane. Letters addressed, post paid, to him at New Stratford, town of Huntington, Connecticut, will find him through the Post Office; and he will, for a reasonable compensation, pack boxes more or less extensive, for mineralogists and others. As Mr. Lane is by occupation a farmer, and is obliged to blast a quartz gangue in order to obtain his specimens, he cannot be expected to transmit them gratis. His mine, which has been sunk only ten feet, affords native bismuth, native silver, magnetical and common iron pyrites, and copper pyrites, (the two latter crystallized) galena, blende, tungsten, tellurium, &c.

It is expected that the shaft will soon be sunk deeper, when probably a more abundant supply of good specimens will be obtained.

N. B. The silver and galena are the least abundant.

March 8th, 1819.

FOOTNOTES:

[28] Vide Edin. Review for Sept. 1818. p. 374.

[29] Referring to the ridges of Greenstone near New-Haven.

[30] Or, according to the Wernerian Geologists, Transition? *Editor.*

[31] The modesty of the writer has prevented him from applying to the formations which he has well described, the terms *transition* and *secondary*, which there can be little doubt do in fact belong to them. His strata of highly inclined limestone, appear to belong to the transition class of Werner, and his flat strata, to the secondary. It may be observed in this place, that the specimens alluded to in the text (passim,) appear to be correctly described by Mr. Cornelius, and to justify his geological inferences as far as hand-specimens seen at a distance from their native beds, can form a safe basis for general geological inductions. *Editor.*

[32] Copied partly from Manuscripts of the late Dr. Muhlenberg, of Lancaster, Pennsylvania.

[33] This large species I understand has been mistaken by a writer on Natural History for *Boa constrictor*: this is mentioned to show how remotely it is possible to diverge from accuracy in this science.

[34] I have been since informed by Mr. Lesueur, that to his taste the poison was bitter.

[35] The terminal caudal plates of this individual were bifid, as in the one of Peale's Museum.

[36] This last is the animal, beyond a doubt, judging from the detailed description and plate, which has lately been erected into a new genus, under the name of Scoliophus............................the identity is immediately obvious, to any one acquainted with the specific characters of the above-mentioned coluber. And I presume it can be made apparent, to any one tolerably versed in the science, should proof be thought necessary.

[37] Dr. Barton remarked that this part is rounded, (cauda teres,) this observation was not autoptical, but dictated most probably by the appearance of Catesby's figure. In the young animal the tail is less compressed than in the old one.

[38] Here we might properly enough notice the high-ways, streets, and pavements of cities, &c. on which the materials being minutely divided by attrition, are in a better state for the sun to act freely on, and will consequently yield greater products than equal areas of undisturbed surface, under like circumstances of heat.

[39] Perhaps there is no body in nature absolutely incombustible, but I use the term here in common acceptation.

[40] It may be easily proved that water evaporates (though slowly) at a temperature many degrees below its freezing point; and these vapours are more subtle and elastic than those formed at the boiling point of that fluid.

REMARK.

It is indeed proved that vapour is formed from water at the lowest temperatures, but is *less elastic*, the lower the temperature, as appears from its sustaining a continually decreasing column of mercury, the lower the temperature at which the vapour is formed. Vide Dalton's and Gay Lussac's experiments. *Editor.*

[41] We have taken the liberty to give Mr. Atwater's Memoir a more extensive Title, for reasons that will be obvious on a perusal of the piece.

[42] Genus, *platanus*—species, *occidentalis*, popular name, sycamore, or button-wood.

[43] The collection of Mr. Perkins became, in 1807, (partly by the liberality of its possessor, and partly by purchase,) the property of Yale College, and is now in the cabinet of that institution. It is believed that few cabinets of equal extent, ever contained more instructive and beautiful specimens, with less that is unmeaning or superfluous. The cabinet of Dr. Bruce has, since his death, been purchased by a gentleman in New-York, for 5000 dollars. *Editor.*

[44] On account of its peculiar cadaverous odour Dr. Hayden proposes to call this mineral (should it prove to be a new one) Necronite, from the Greek Νεκρος.

[45] That is, the inner bark deprived of the epidermis or outer bark, by the shaving knife.

CONTENTS.

GEOLOGY, TOPOGRAPHY, AND MINERALOGY.

THE

AMERICAN

JOURNAL OF SCIENCE, &c. [317]

GEOLOGY, TOPOGRAPHY, AND MINERALOGY.

Art. I. *On the Geology, Mineralogy, Scenery, and Curiosities of Parts of Virginia, Tennessee, and of the Alabama and Mississippi Territories, &c. with Miscellaneous Remarks, &c. In a Letter to the Editor.* By the Rev. Elias Cornelius.

(Concluded from page 226.)

I will conclude this part of the narrative with a brief notice of a few curiosities occurring in the region which has been described.

Caves.

1. It is well known that it furnishes a great number of interesting *caves*. They are found alike in the inclined and horizontal strata. Some of them are several miles in extent, and afford fine specimens of earthy and alkaline salts.

Wier's cave in Virginia has been described by Mr. Kain. I have in my possession a map of its most important apartments, including its whole length, copied from a survey made by Mr. J. Pack in Oct. 1806; also the notes of another survey made in May 1816, by the Rev. Conrad Speece of Augusta county, and Mr. Robert Grattan; which, with an explanation, and particular description, I [318] hope to be able to transmit to you at a future time.

From these surveys, it appears that the whole extent of the cave, hitherto discovered, does not exceed eight hundred yards. This was the length stated to me by the guide, when I visited it in August, 1817. I cannot but think there is some mistake in Mr. Kain's remark, that "it is a mile and a half in extent." I spent four hours in examining every accessible part, and by permission of Mr. Henry Bingham, the owner, made a large collection of specimens, which were transmitted for the Cabinet of Yale College.[46]

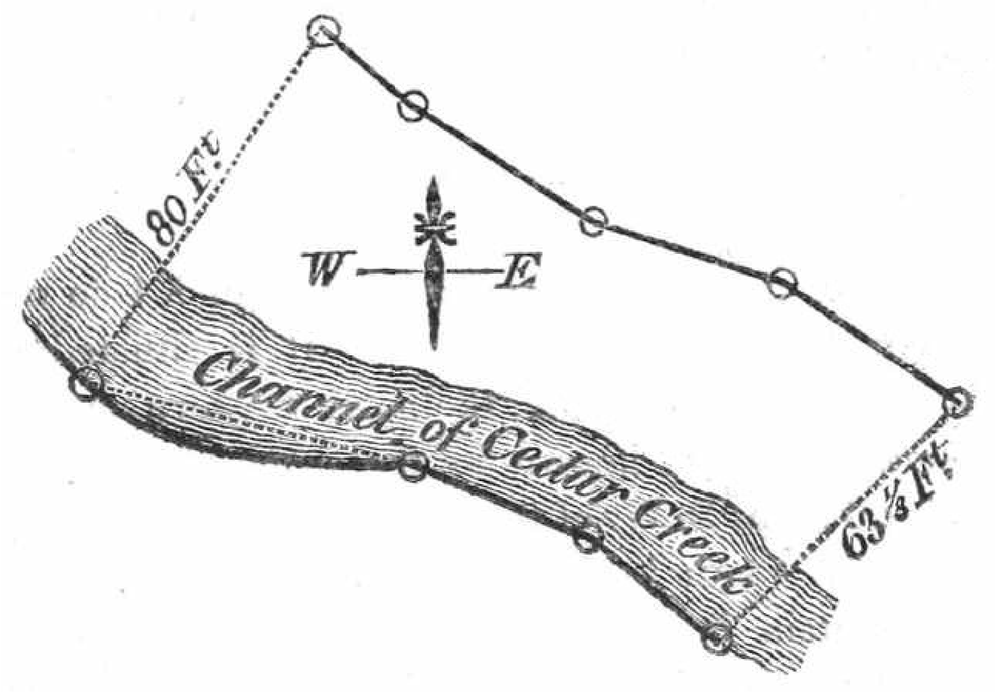
The Natural Bridge.

2. My object m naming this celebrated curiosity, is not to give a new description of it, but merely to furnish a correct account of its dimensions. I visited it in company with the Rev. Mr. Huson, who had previously found its height by a cord, to be two hundred and ten feet. We now found it by the quadrant, to be two hundred and eleven feet, and the arch through the centre about forty feet.

Some have attempted to account for this great curiosity, by supposing that a convulsion in nature may have rent the hill, in which it stands, asunder; thus forming the deep and narrow defile, over which the rocky strata were left, which constitute its magnificent arch. If so; the sides should have corresponding parts. At a distance from the base, no such correspondence is perceptible. At the base, the rocks are more or less craggy and irregular. This led me to take the courses and distances of each side. The following was the result.

Eastern side presents 4 angular points.				Western side presents 3 angular points.			
1.	N. 55°	W. 1 chain.	09 links.	1.	N. 50°	W. 0 chain.	45 links.
2.	N. 72	W. 1 ——	05½ ——	2.	N. 67	W. 1 ——	12½ ——
3.	N. 57	W. 1 ——	12½ ——	3.	N. 77	W. 1 ——	44 ——
4.	N. 50	W. 0 ——	33 ——				

The chain used contained 50 links, equal to 33 feet and ⅓. The distance between the abutments [319] at the north end of their bases, is 80 feet; at the south end, 66 feet. As they ascend, the distance is greater. These data give the following diagram.



Although considerable resemblance appears at the base, yet as no such correspondence is visible 40 feet above it, and the sides for the whole remaining distance to the arch, one hundred and thirty feet, lose their craggy appearance entirely, and present the smooth, irregular surface of the oldest rocks. I am led to think that the natural bridge is coeval with a very remote period of time. Nor is there any difficulty even in supposing it to have proceeded from the hand of the Almighty, as it is; for great and marvellous are all his works!

The following anecdote will evince the effect which the sight of the natural bridge produced on a servant, who, without having received any definite or adequate ideas of what he was to see, attended his master to this spot.

On the summit of the hill, or from the top of the Bridge, the view is not more awful than that which is seen from the brink of a hundred other precipices. The grand prospect is from below. To reach it you must descend the hill by a blind path, which winds through a thicket of trees, and terminates at the instant when the whole bridge with its broad sides and lofty arch, all of solid [320] rock, appears perfectly in sight. Not one in a thousand can forbear to make an involuntary pause: but the servant, who had hitherto followed his master, without meeting with any thing particularly to arrest his attention, had no sooner arrived at this point, and caught a glance of the object which burst upon his vision, than he fell upon his knees, fixed in wonder and admiration.

A River flowing from a Cave.

3. I will next mention *a singular cave*, which I do not remember ever to have seen described. It is situated in the Cherokee country, at Nicojack, the north-western angle in the map of Georgia, and is known by the name of the Nicojack cave. It is 20 miles S. W. of the Look-Out mountain, and half a mile from the south bank of the Tennessee River. The Rackoon mountain in which it is situated, here fronts to the northeast. Immense layers of horizontal limestone form a precipice of considerable height. In this precipice the cave commences; not however with an opening of a few feet, as is common; but with a mouth fifty feet high, and one hundred and sixty wide. Its roof is formed by a solid and regular layer of limestone, having no support but the sides of the cave, and as level as the floor of a house. The entrance is partly obstructed by piles of fallen rocks, which appear to have been dislodged by some great convulsion. From its entrance, the cave consists chiefly of one grand excavation through the rocks, preserving for a great distance the same dimensions as at its mouth.

What is more remarkable than all, it forms for the whole distance it has yet been explored, a walled and vaulted passage, for a stream of cool and limpid water, which, where it leaves the cave, is six feet deep and sixty feet wide. A few years since, Col. James Ore of Tennessee, commencing early in the morning, followed the course of this creek in a canoe, for three miles. He then came to a fall of water, and was obliged to return, without making any further discovery. Whether he penetrated three miles up the cave or not, it is a fact he did not return till the evening, having been busily engaged in his subterranean voyage for twelve hours. He stated that [321] the course of the cave after proceeding some way to the southwest became south; and southeast by south, the remaining distance.

Natural Nitre.

The sides of the principal excavation present a few apartments which are interesting, principally because they furnish large quantities of the earth from which the nitrate of potash is obtained. This is a circumstance very common to the caves of the western country. In that at Nicojack, it abounds, and is found covering the surfaces of fallen rocks, but in more abundance beneath them. There are two kinds, one is called the "clay dirt," the other the "black dirt;" the last is much more strongly impregnated than the first. For several years there has been a considerable manufacture of saltpetre from this earth. The process is by lixiviation and crystallization, and is very simple. The earth is thrown into a hopper, and the fluid obtained, passed through another of ashes, the alkali of which decomposes the earthy nitrate, and uniting with its acid, which contains chiefly nitrate of lime, turns it into nitrate of potash. The precipitated lime gives the mass a whitish colour, and the consistence of curdled milk. By allowing it to stand in a large trough, the precipitate, which is principally lime, subsides, and the superincumbent fluid, now an alkaline, instead of an earthy nitrate, is carefully removed and boiled for some time in iron kettles, till it is ready to crystallize. It is then removed again to a large trough, in which it shoots into crystals. It is now called "rough shot-petre." In this state it is sent to market, and sells usually for sixteen dollars per hundred weight. Sometimes it is dissolved in water, reboiled, and recrystallized, when it is called refined, and sells for twenty dollars per hundred. One bushel of the clay dirt yields from 3 to 5lbs. and the black dirt from 7 to 10lbs. of the rough shot-petre. The same dirt, if returned to the cave, and scattered on the rocks, or mingled with the new earth, becomes impregnated with the nitrate again, and in a few months may be thrown into the hopper, and be subjected to a new process.

The causes which have produced the nitric salts of these caves, may not yet have been fully [322]
developed. But it is highly probable, they are to be ascribed to the decomposition of animal substances.

It is reasonable to suppose, that in an uncultivated country they would become the abodes of wild animals, and even of savage men. That they have been used by the natives as burial places, is certain. In one which I entered, I counted a hundred human skulls, in the space of twenty feet square. All the lesser and more corruptible parts of each skeleton had mouldered to dust, and the whole lay in the greatest confusion. I have heard of many such caves, and to this day some of the Indians are known to deposit their dead in them. From the decomposition of such substances, it is well known the acid of the nitric salts arises, and it would of course unite with the lime every where present, and form nitrate of lime.

Mounds.

4. I have but one more article of curiosity to mention under this division. It is one of those artificial *mounds* which occur so frequently in the western country. I have seen many of them, and read of more. But never of one of such dimensions as that which I am now to describe.

It is situated in the interior of the Cherokee nation, on the north side of the Etowee, vulgarly called Hightower River, one of the branches of the Koosee. It stands upon a strip of alluvial land, called *River Bottom*. I visited it in company with eight Indian chiefs. The first object which excited attention was an excavation about twenty feet wide, and in some parts ten feet deep. Its course is nearly that of a semicircle; the extremities extending towards the river, which forms a small elbow. I had not time to examine it minutely. An Indian said it extended each way to the river, and had several unexcavated parts, which served for passages to the area which it encloses. To my surprise, I found no embankment on either side of it. But I did not long doubt to
what place the earth had been removed; for I had scarcely proceeded two hundred yards, when, [323]
through the thick forest trees, a stupendous pile met the eye, whose dimensions were in full proportion to the intrenchment. I had at the time no means of taking an accurate admeasurement. To supply my deficiency, I cut a long vine, which was preserved until I had an opportunity of ascertaining its exact length. In this manner I found the distance from the margin of the summit to the base, to be one hundred and eleven feet. And judging from the degree of its declivity, the *perpendicular height* cannot be less than seventy-five feet. The circumference of the base, including the feet of three parapets, measured one thousand one hundred and fourteen feet. One of these parapets extends from the base to the summit, and can be ascended, though with difficulty, on horseback. The other two, after rising thirty or forty feet, terminate in a kind of triangular platform. Its top is level, and at the time I visited it, was so completely covered with weeds, bushes, and trees of most luxuriant growth, that I could not examine it as well as I wished. Its diameter, I judged, must be one hundred and fifty feet. On its sides and summit, are many large trees of the same description, and of equal dimensions with those around it. One beach-tree, near the top, measured ten feet nine inches in circumference. The earth on one side of the tree, was three and a half feet lower than on the opposite side. This fact will give a good idea of the degree of the mound's declivity. An oak, which was lying down on one of the parapets, measured at the distance of six feet from the butt, without the bark, twelve feet four inches in circumference. At a short distance to the southeast is another mound, in ascending which I took thirty steps. Its top is encircled by a breastwork three feet high, intersected through the middle with another elevation of a similar kind. A little farther is another mound, which I had not time to examine.

On these great works of art, the Indians gazed with as much curiosity as any white man. I inquired of the oldest chief, if the natives had any tradition respecting them; to which he answered in the negative. I then requested each to say what he supposed was their origin.
Neither could tell: though all agreed in saying; "they were never put up by our people." It seems [324]
probable they were erected by another race, who once inhabited the country. That such a race existed, is now generally admitted. Who they were, and what were the causes of their degeneracy, or of their extermination, no circumstances have yet explained. But this is no reason why we should not, as in a hundred other instances, infer the existence of the cause from its effects, without any previous knowledge of its history.

In regard to the objects which these mounds were designed to answer, it is obvious they were not always the same. Some were intended as receptacles for the dead. These are small, and are distinguished by containing human bones. Some may have been designed as sites for public buildings, whether of a civil or religious kind; and others no doubt were constructed for the purposes of war. Of this last description, is the Etowee mound. In proof of its suitableness for such a purpose, I need only mention that the Cherokees in their late war with the Creeks, secured its summit by pickets, and occupied it as a place of protection for hundreds of their women and children. Gladly would I have spent a day in examining it more minutely; but my companions, unable to appreciate my motives, grew impatient, and I was obliged to withdraw, and leave a more perfect observation and description to some one else.

Alluvial Formation.

I will now call your attention to the last geological division which came under my observation. It is the alluvial tract, extending from the Dividing Ridge already mentioned, to the Gulf of Mexico. This Ridge is the last range of high land which I crossed on the journey to New Orleans, and lies about six hundred miles north of the Gulf of Mexico. Its course at the place I crossed it, is a little south of west. It divides the waters of the Tennessee from those which proceed directly to the gulf. Travellers always observe it. They often mentioned it to me as the southern boundary of the *stony country*. After crossing it, you see no more limestone; and, which excites more joy in the traveller, no more of the silicious gravel, with which it is associated, and which is so [325] troublesome to the feet of horses. The soil consists of a soft clay, or light sand, on which you seldom meet with a stone of any kind. The surface of the earth is undulating and hilly, but not mountainous. The water-courses do not move rapidly and tumultuously, as in the limestone country; but form in the soft earth, deep trenches, through which they glide smoothly and silently along. The smallest rivulet often has a trench ten feet deep; and the earth over which it passes, is continually yielding to its gentle attrition.

The only minerals which I observed, are sandstone, common and ferruginous; silicious pebbles in beds of creeks, and occasionally on the uplands; earthy ores of iron, particularly red oxides, and petrifactions of shells, wood, &c. In addition to these, it may here be mentioned that galena has been found in small quantities at Gibson's Port, and at Ellis's Cliffs, in the State of Mississippi: a crystal of amethyst, in the same state, by Mr. Blannerhassett; and a great variety of useful ochres, in many places on the banks of the Mississippi.

In the geological map attached to Professor Cleaveland's Mineralogy, the alluvial country bordering on the Gulf of Mexico, is represented as terminating at Natchez. But why its termination is placed here, I am unable to understand. The country above and below Natchez, so far as it has come under my observation, presents no difference of appearance in its geology, or mineralogy. I am aware that at Natchez, when the water of the Mississippi is lowest, a soft rock is seen, from which lime has been obtained. But this rock is two hundred feet below the surface of the adjoining country; and admitting that it is a limestone rock, there is no difficulty in supposing it may constitute the basis of the alluvial deposit which rests upon it. That the incumbent earth is *alluvial*, can be doubted, I think, by no one who has had an opportunity of examining it. By means of a road, which has been cut obliquely down the side of the bluff, distinct layers of clay, sand, and pebbles, have been exposed for the whole distance from the summit to the base. The same character is observed at a distance from the river, where the earth has been excavated by washing, or digging. In the vicinity of the town, there is a curious exhibition of the [326] fact. A stream of water has worn away the earth to the depth of fifteen or twenty feet, and is continually lengthening the chasm, in the direction opposite to its own course. Thus, as the water flows from the town, the chasm approaches it. In examining the cause of this fact, I perceived it was owing chiefly to the difference of cohesion in the alluvial deposits, of which the earth is formed. That at the surface, being a thick loam, wears away with more difficulty than the deposit below it, which consists of a loose sand. The consequence is, that the water, which has once obtained a perpendicular passage of a few inches through the first, washes away the second with such rapidity, that it is constantly undermining it. This occasions a perpetual caving in of the surface, in a direction opposite to the course of the stream. The same fact is observed in many parts of the country for a great distance above Natchez. If there be wanting any other fact to prove that the earth on which the town of Natchez stands, is alluvial, it is found in the effect which the Mississippi has upon the base of the Natchez bluff. In consequence of a bend in the river, the whole force of its current is thrown against this base. If it consisted of solid rock, the river would probably have no effect upon it; but of such loose and friable materials is it composed, that the river is continually undermining it, and producing effects not less to be dreaded than those of an earthquake. Several years ago, a great number of acres sunk fifty feet or more below the general surface of the hill; and in 1805, there was another caving of that part directly over the small village at the landing. Several houses were buried in consequence of it, and strong fears are entertained by the inhabitants, that the same cause will yet submerge in the Mississippi, the whole of the present landing-place.

These facts, I think you will say, furnish satisfactory evidence of the alluvial character of the country at Natchez. The same character belongs to the whole extent south of the Dividing Ridge. This may be safely inferred from the general features of the country. But I have two facts, of a geological kind, to mention, both of which go to confirm the opinion.

1. A well was dug in the Choctaw nation, at the agency of the United States, in the year 1812 or [327] 1813, under the direction of Silas Dinsmore, Esq. the agent. The excavation was continued to the depth of one hundred and seventy-two feet. No water was found. At no great distance from the surface, marine exuviæ were found in abundance. The shells were small, and imbedded in a soft clay, similar to marine earth. This formation continued till the excavation ceased. Dispersed

through it, were found lumps of selenite, or foliated gypsum, some of which were half as large as a man's fist. Specimens of the earth, the exuviæ, and the selenite, have been transmitted for your examination. This excavation was made one hundred and twenty miles north northeast of Natchez. The Pearl River is four miles to the east of the place, and is the only considerable stream in this part of the country.

2. In the Chickasaw nation, one hundred and seventy miles north of the Choctaw agency, commence beds of oyster-shells, which continue to be seen at intervals for twelve miles. Four miles from the first bed, you come to what is called "Chickasaw Old Town," where they are observed in great abundance. They are imbedded in low ridges of a white marl. They appear to be of two kinds. Specimens of each, and also of the marl, you have received. "Chickasaw Old Town," is a name now appropriated to a prairie, on a part of which there formerly stood a small village of Chickasaws. The prairie is twenty miles long, and four wide. The shells occur in three places as you cross it, and again, on two contiguous hills to the east of it, at the distance of four miles. They do not cover the surface merely. They form a constituent part of the hills or plains in which they are found. Wherever the earth has been washed so as to produce deep gutters, they are seen in greatest abundance. Nor are they petrifactions, such as are found in rocks. They have the same appearance as common oyster-shells, they lie loose in the earth, and thus indicate a comparatively recent origin. They occur *three hundred miles* northeast of Natchez, and but *sixty* miles south of the Dividing Ridge.

If the country north of Natchez is alluvial, no one will doubt it is so from this place to the Gulf of Mexico. At Baton Rouge, one hundred and forty miles north of New Orleans, you meet the first elevated land in ascending from the gulf. The banks of the Mississippi are higher than the interior, and would be annually overflowed by the river, but for a narrow embankment of earth about six feet high, called the Levee. By means of this, a narrow strip of land, from half a mile to a mile in width, is redeemed, and cultivated with cotton and the sugar cane, to the great advantage of the planter. Generally, within one mile from the river, there is an impenetrable morass. The country has every where the appearance of an origin comparatively recent. Not a rock on which you can stand, and no mountain to gladden the eye; you seem to have left the older parts of creation to witness the encroachments which the earth is continually making upon the empire of the sea; and on arriving at the mouth of the Mississippi, you find the grand instruments of nature in active operation, producing with slow, but certain gradations, the same results. [328]

A destructive Insect.

But I will not enlarge on a fact already familiar. I will ask your further indulgence only, while I communicate an authentic and curious fact for the information of the zoologist.

In the Choctaw country, one hundred and thirty miles northeast of Natchez, a part of the public road is rendered famous on account of the periodical return of a poisonous and destructive fly. Contrary to the custom of other insects, it always *appears* when the *cold weather* commences in December, and as invariably *disappears* on the approach of *warm weather*, which is about the first of April. It is said to have been remarked first in the winter of 1807, *during a snowstorm*; when its effects upon cattle and horses were observed to be similar to those of the gnat and musqueto, in summer, except that they were more severe. It continued to return at the same season of the year, without producing extensive mischief, until the winter of 1816, when it began [329] to be generally fatal to the horses of travellers. So far as I recollect, it was stated, that from thirty to forty travelling horses were destroyed during this winter. The consequences were alarming. In the wilderness, where a man's horse is his chief dependence, the traveller was surprised and distressed to see the beast sicken and die in convulsions, sometimes within three hours after encountering this little insect. Or if the animal were fortunate enough to live, a sickness followed, commonly attended with the sudden and entire shedding of the hair, which rendered the brute unfit for use. Unwilling to believe that effects so dreadful could be produced by a cause apparently trifling, travellers began to suspect that the Indians, or others, of whom they obtained food for their horses, had, for some base and selfish end, mingled poison with it. The greatest precaution was observed. They refused to stop at any house on the way, and carried, for the distance of forty or fifty miles, their own provision; but after all suffered the same calamities. This excited a serious inquiry into the true cause of their distress. The fly, which has been mentioned, was known to be a most singular insect, and peculiarly troublesome to horses. At length it was admitted by all, that the cause of the evils complained of could be no other than this insect. Other precautions have since been observed, particularly that of riding over the road infested with it *in the night*; and now it happens that comparatively few horses are destroyed. I am unable to describe it from my own observation. I passed over the same road in April last, only two weeks after it disappeared, and was obliged to take the description from others. Its colour is a dark brown; it has an elongated head, with a small and sharp proboscis; and is in size between the gnat and musqueto. When it alights upon a horse, it darts through the hair, much like a gnat, and never quits its hold until removed by force. When a horse stops to drink, swarms fly about the head, and crowd into the mouth, nostrils, and ears; hence it is supposed the poison is communicated inwardly. Whether this be true or not, the most fatal consequences result. It is singular, that from the time of its first appearance, it has never extended for a greater distance [330] than forty miles, in one direction, and usually, it is confined to fifteen miles. In no other part of the country has it ever been seen. From this fact, it would seem probable that the cause of its existence is local. But what it is, none can tell. After the warm weather commences, it disappears as effectually from human observation, as if it were annihilated. Towards the close of December it springs up all at once into being again, and resumes the work of destruction. A fact, so singular, I could not have ventured to state, without the best evidence of its reality. All the circumstances here related, are familiar to hundreds, and were in almost every man's mouth, when I passed through the country. In addition to this, they were confirmed by the account which I received from Col. John M'Kee, a gentleman of much intelligence and respectability, who is the present agent of the general government for the Choctaw nation. He has consented to obtain specimens of the insect for your examination, when it returns again; and will, I hope, accompany the transmission with a more perfect description than it has been possible for me to communicate.

In concluding this narrative of facts, I should be glad to take a comprehensive view of the whole. The bold features in the geology of the United States, as they are drawn by the Blue Ridge, the Cumberland with its associated mountains, and the Dividing Ridge, deserve to be distinctly and strongly impressed upon the mind. Such is the order and regularity of their arrangement, that they can hardly fail to conduct the attentive observer to important results. What has now been said of them, is but an epitome of the whole. I trust the public will soon read, in the pages of your Journal, a detail more perfect and more interesting. And allow me to suggest, whether, under the auspices of our learned societies, some men of science might not be employed and supported in exploring the country, with the prospect of greatly enlarging the science of our country, and of enriching our Journals and Cabinets of Natural History. Tours of discovery have often been made for other objects, and with success. Our country yields to no [331] other in the variety, or the value of its natural productions. We owe it to ourselves and to the world, to search them out with diligence and without delay.

Somers, (N. Y.) Oct. 1818.

Art. II. *On the Origin of Prairies.*

St. Louis, (Missouri Ter.) March 3, 1819.

Sir,

The probable cause of the origin and continuance of *prairies* has been the subject of much speculation among the learned and curious. The inquiry is interesting; and many theories have arisen; but although plausible and ingenious, they are, in my opinion, unfounded in fact.

I should be glad to see the following remarks, which were called forth more particularly by the speculations of Caleb Atwater, Esq. (See No. 2. p. 116. of this work) appear in your valuable Journal of Science; and they are, for that purpose, at your service.

With high respect, I am, Sir, your's,

R. W. WELLS.

Benjamin Silliman, Esq.

Mr. Atwater, after describing the prairies and barrens, says, that according to the common opinion, they "were occasioned entirely by the burning of the woods," but, "erroneous information first propagated such an opinion, and blind credulity has extended it down to us." Mr. A. goes on to affirm that, "wherever prairies and barrens are found, there, for a long space of time, water once stood, but was gradually drained off." The writer of this having often visited and observed with attention the nature and appearance of the prairies on the Alleghany mountains, in the states of Ohio, Indiana, and Illinois, and having long been employed by the United States as a surveyor in the prairie country of the Missouri and Missisippi, thinks he may venture to oppose [332] these speculations without being thought presumptuous. He is of opinion, that the vast prairies and barrens, extending over the greater part of the western states, and over nearly all Louisiana, were primitively occasioned, and have been since continued, by the *combustion of vegetables*, and that *water* had no agency in their formation.

In order to prove the high prairies of the state of Ohio to have been once covered by the waters of Lake Erie, Mr. A. maintains, that the channel of the Niagara river has been worn down "*several hundred feet*" by the attrition of its waters. Mr. A. should have shown, that the banks of the Niagara are, at this time, several hundred feet high, or, like the Potomac, at Harper's Ferry, has broken through a mountain "several hundred feet" high; but neither the one nor the other is the fact; the face of the country, on either side of the river, is comparatively low and champaign; and were it possible for the waters of the lake to rise considerably above their present level, they would meet with no obstruction or impediment, for many miles on either side the river, but would be precipitated over the cataract, into Ontario, and down the St. Lawrence to the Atlantic. But supposing there had been a mountain running between Lakes Erie and Ontario of sufficient height to prevent the water of the former from passing into the latter, it must evidently have found other places through which to escape, and before it would rise high enough to overflow the elevated region of Madison and Fayette counties, in Ohio, it would have passed over into the heads of the Alleghany. But it is impossible to imagine this, unless we suppose the Atlantic to have been six or seven hundred feet higher than at present, which, according to Mr. A. would have made prairie of all the Atlantic states.

The fact of shells and other marine substances having been found in a few places, by digging in the prairies, proves nothing, or proves too much, for they are found in equal or greater quantities all over America, in the sides and near the summit of the Alleghany mountains; on the Andes, in South America, and the Alps, in Europe. The resemblance which the soil, in the low prairies, and [333] not in the high, bears to the *alluvial*, can justly be attributed, it is presumed, to the leaves and other vegetables and light materials of which they are composed, having been washed by heavy rains, for ages past, from the higher to the lower places. This will also account for the circumstance of trees growing upon the summits of the hills of steep ascent: being thin and poor, the grass neither grows sufficiently long or thick to kill the timber when fired. They *could not* have been islands in this fairy lake; because their summits are frequently much *lower* than high prairie flats a few miles distant. These are facts which will be recollected by those who have ever travelled through a prairie country of any extent.

But suppose it to have been proved, that the waters of Lake Erie once overspread the state of Ohio, from its present shore to Chillicothe, (a supposition which I trust has however been shown to be visionary) does it follow that the prairies were occasioned by such overflowing? If the water, by covering the country, prevented the timber from growing, should we not naturally look for the largest timber on the higher grounds which would be first forsaken by the waters, and for small timber on the low grounds, where the water remained longest? If this be true, (and it is unquestionable) we should then look for prairies on the low grounds bordering on Lakes Erie, Huron, and Michigan; and the thickly timbered country would be on the high land, near the sources of the rivers. But the contrary is absolutely the fact: we find heavy timbered land, and no *prairies*, in the low countries north of the lakes, and none south, either in Michigan territory or elsewhere, until we arrive near the sources of the rivers. It is true, that the water standing in ponds will prevent the timber from growing; but the difference is readily observed between prairies, properly so called, and those bogs.

But to prove farther that water had no agency in bringing the prairies into existence, we may mention those on and near the summit of the Alleghany mountains, (principally in Alleghany [334] County.[47]) Many of those prairies are ten or twelve miles in length, and three or four in width. Will it be pretended that the sides of those mountains were also lakes? Farther—the most extensive prairies known, are the very high plains immediately west of the Rocky Mountains, and east of the mountains near the sources of the Arkansaw and Missouri rivers, extending even on the spurs of those mountains; a country the highest perhaps in North America, with a great and continued descent to the Pacific on the one side, and to the Gulf of Mexico on the other.

The barrens, also, found in Kentucky, are another evidence that water had no agency in their formation—they are situate, it is believed, in the elevated parts of the country exclusively.

The writer of this, deeming it unnecessary to say more, or to produce more facts, (although much more may be said, and many more facts produced) to prove that prairies were not lakes, will now endeavour to prove that they were occasioned by the *combustion of vegetables*.

Prairies are found in those countries only that are congenial to the growth of grass, and only where the soil is sufficiently rich to produce it luxuriantly—they are found commonly on high plains, sufficiently drained to prevent water from remaining on them the whole year; for it is by no means necessary that they should be always dry; on the contrary, if they are sufficiently level to prevent the rains from running off immediately, the grass will grow thicker and higher—but they must be sufficiently dry to burn, at least once in two or three years, during the long, dry season, called *Indian summer*. It has been universally remarked, that these seasons are much longer as we proceed westerly—commencing usually in October, and continuing a month and a half or two months, during which the vegetation is killed by the frosts, and dried by the sun; the wet prairies are also dried, and before the season has expired, the grass is perfectly combustible.

The Indians, it is presumed, (and the writer, from a residence in their country and with them, is [335] well acquainted with their customs) burn the woods, not *ordinarily* for the purpose of taking or catching game, as suggested by Mr. A. but for many other advantages attending that practice. If the woods be not burned as usual, the hunter finds it impossible to kill the game, which, alarmed at the great noise made in walking through the dry grass and leaves, flee in all directions at his approach. Also the Indians travel much during the winter, from one village to another, and to and from the various hunting grounds, which becomes extremely painful and laborious, from the quantity of briers, vines, grass, &c. To remedy these and many other inconveniences, even the woods were originally burned so as to cause prairies, and for the same and like reasons they continue to be burned towards the close of the Indian summer.

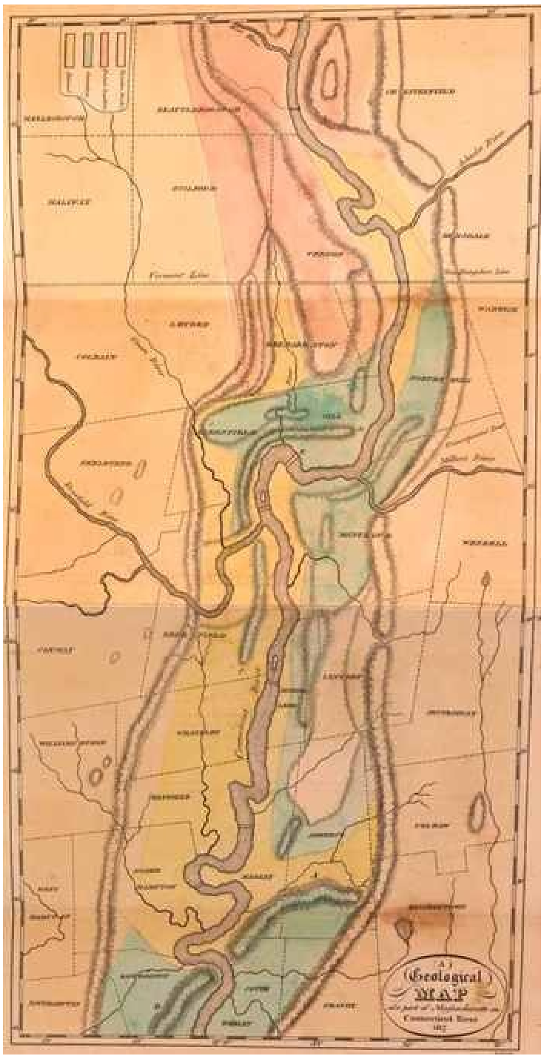
Woodland is not commonly changed to prairie by one burning, but by several successive conflagrations; the first will kill the undergrowth, which causing a greater opening, and admitting the sun and air more freely, increases the quantity of grass the ensuing season: the conflagration consequently increases, and is now sufficiently powerful to destroy the smaller timber; and on the third year you behold an open prairie.

Ordinarily, all the country, of a nature to become prairie, is already in that state; yet the writer of this has seen, in the country between the Missouri and Mississippi, after unusual dry seasons, more than one hundred acres of woodland together converted into prairie. And again, where the grass has been prevented from burning by accidental causes, or the prairie has been depastured by large herds of domestic cattle, it will assume, in a few years, the appearance of a young forest. Numerous proofs of this fact can be adduced, but a few shall suffice. The vicinity of St. Louis and St. Charles affords instances. Both these beautiful places are situated on what are termed first and second bottoms, or flats—the former on the Missisippi, the latter on the Missouri; the second or upper bottoms, in both, are high plains, that commence within a few hundred yards of the rivers, and extend back many miles; all the old French inhabitants will tell you, that the prairies [336] formerly came immediately up to those places. Now the surrounding country for several miles is covered with a growth of trees of four or five inches diameter, near the towns where the burning first ceased, and gradually diminishing in size as you recede, until you at length gain the open prairies. So the barrens in Kentucky; many of the first settlers of that state distinctly recollect when many of those barrens were clear prairies, now partially covered with small trees. It is deemed unnecessary to offer more proofs, or additional arguments, in support of the opinion that the prairies were occasioned by *fire*, and not by *water*. Indeed one glance at the maps of those extensive prairie countries, surveyed by order of government, where the prairies and woodland are distinguished and correctly delineated, should carry conviction. The timber will be there observed to skirt the rivers; in the country near their sources a few solitary trees are seen, close on the banks, secure from the fires, and increasing in numbers as the rivers increase in size, and the low grounds become more extensive.

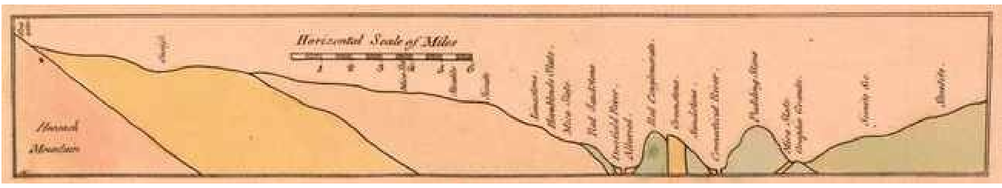
The view given of the prairies by Mr. A. is correct; but was certainly painted in the *winter* season—they are, at that season, bleak and uncomfortable both to the feelings and sight; but a full return is made to both when the spring opens. The prairies (particularly to the west) are then covered with the richest verdure, interspersed with an immense variety of wild flowers, that send forth the most grateful odours. Ascend one of the small hills, and you have a prospect as delightful as it is possible for the imagination to conceive. Far as the eye can carry you, a delightful country extends, through which numerous streams wind their serpentine courses, with groves and clumps of trees at intervals upon their banks. On one hand, at an immense distance, the small hills and groves are seen rising above the blue horizon; on the other, the view is pleasantly terminated by the wood on the low grounds skirting the river to which the smaller streams are tributary—while herds of buffalo, elk, deer, and other animals, are frequently seen slowly travelling to and from the watering-places, or grazing on the plains. The inhabited parts of [337] the country present a prospect still more pleasing; around the margin of those extensive rich prairies, numerous habitations are seen, withdrawn a short distance in the wood, from the winter's cold and summer's heat—their finely cultivated fields lie in the prairies, which yield at once to the plough, without the previous Herculean labour of demolishing the forest. The area between the farms is a common of pasture to the numerous herds during the spring, summer, and autumn, and a small part mowed affords hay for the winter. The farmer who takes up his habitation in the neighbourhood of the prairies, has *many* of the advantages of an *old* inhabited country, and *all* the advantages of the *new*.

Art. III. *Sketch of the Mineralogy and Geology of the Vicinity of Williams' College, Williamstown, Mass. By* Professor Dewey, *of Williams' College, in a letter to the Editor*.

The following sketch includes a space extending from Hoosack mountain on the east, to the State of New-York on the west, and a small distance into Vermont on the north. The accompanying map shows the relative situation of the streams, and the principal hills and mountains. The map is an enlarged copy of Carleton's map of this part of the state, with one or two corrections, which truth required. The latitude and longitude are probably not perfectly accurate.



A Geological MAP *of a part of Massachusetts on* Connecticut River 1817.



Transverse Section of Rock Strata from Hoosack Mountain to Eleven Miles East of Connecticut River.

Williams' College is situated in a valley, having on the west the hills of the *Taconick*[48] range; on the east, *Saddle Mountain*, which separates it for the most part from Adams; and on the north, and northeast, two hills which belong to the southwestern part of the range of the *Green Mountains*. *Hoosack River*, rising several miles at the southeast, and passing through the northeastern part of Williamstown, winds its course northwest, to the Hudson. [338] It is an inconsiderable stream, about six rods in width, and its current is rapid. From the south, runs *Green River*, a smaller stream, and enters the Hoosack one mile northeast of the college. The *green* colour of this stream, appears to be caused by a *magnesian* clay, which is washed from its banks at the south part of the town. At the west is *Westbrook*, rising in Williamstown, and entering the Hoosack one mile and a half northwest of the college. The *soil* in this whole tract is generally *clayey*, rather light for such a soil, and very rich. A gravelly soil appears in a few places, especially at the northern part. The *interval* on the Hoosack extends only a small distance from its banks, rarely exceeding, and often much less, than half a mile, and presents the common appearances of *alluvial* land. Rising from ten to twenty feet above this interval, the soil is in various places filled with rolled stones of quartz and limestone, as if the Hoosack had once been much above the banks which confine it at present. It is not improbable that its waters were formerly intercepted by the hills in Pownal, five miles at the northwest, forming a small lake in this valley.

The hills of the *Taconick* range, (A[49]) on which passes the line between Massachusetts and New-York, have generally an elevation from twelve hundred to fourteen hundred feet; *Pownal Mountain* (B) on the north, about fourteen hundred; and *Oak hill* (D) on the northeast, twelve hundred feet above the east college (C.) *Saddle Mountain* (EF) is an insulated mass, separated from the Taconick range by the valley of Williamstown, and from Hoosack Mountain, by the valley in Adams. It lies about south southwest, and is nearly eight miles in length, and two in breadth. It is composed of two ranges, the eastern and highest (FG) being in Adams. The mountain has its name from two of its peaks, which present at a distance the appearance of the two elevations of a *saddle*. The west range (E) is divided into *two parts* quite to its base, which with the slope of the east range encloses, on three sides, an irregular hollow, called the *Hopper*. (H) The northern part (E) of the west range is nearly two miles in length, and rises to the height [339] of eighteen hundred feet; the southern (I) rises abruptly into a peak of the elevation of seventeen hundred feet. The height of the valley between the two ranges is about fourteen hundred feet. You enter the *Hopper* from the west, passing along a branch of Green River, and a romantic, wild, and sublime prospect opens before you. Nearly east of the entrance into the Hopper, lies the highest point of the Saddle, familiarly called *Gray Lock*, (F) being about twenty-eight hundred feet above the college, and probably four thousand feet above the *tide-water* of the Hudson at Troy. This is the highest land in Massachusetts. About two miles north northeast, is the northern peak (G) elevated twenty-three hundred feet. The valley in Adams is bounded on the east by Hoosack mountain, (K) elevated from fourteen hundred to eighteen hundred feet, and extending several miles west of south: it forms a part of the range which commences at *West Rock* in Connecticut.

The country included in this sketch is principally *primitive*; lying on the west of the summit of the primitive range, which passes southerly into Connecticut. The rocks and minerals will be mentioned in the following order.

1. *Granite.* A few pieces have been found at the foot of Oak hill, one mile northeast of the college. It consists principally of feldspar. Four miles east, are large masses of granite on both sides of the Hoosack, and on ascending Hoosack mountain they become more numerous. The principal part of this is quartz, often of a purple colour; the mica black, and the rocks exceedingly hard. I have never noticed any minerals imbedded in it. The vortex of Pownal mountain is also granitic.

2. *Gneiss* and *Mica Slate*. I connect these two, because they are not often distinct, and appear to pass into each other. They are found in large strata on Hoosack Mountain, on a hill (L) connected with Saddle Mountain, and on the east side of Saddle Mountain. The highest and the west ridge of Saddle Mountain are mica slate. The *Hopper* shows the inclination of the strata quite to the base of the mountain. The inclination is to the east and northeast, from ten to forty [340] degrees. On the southwest mountain of *Saddle*, the strata are bare to the summit for a considerable distance, and are very fine grained mica slate, having somewhat the appearance of a *soapstone slate*. By this name they are called in Mr. Eaton's Index to Geology. Some of the rocks appear to be *talcose*. I have been able, however, to detect but a very minute quantity of magnesia in any specimens I have tried, though I obtained a considerable proportion of alumine. The higher hills of the Taconick range are composed principally of a similar slate, lying in the same direction, and with similar inclination; but it appears to have passed still farther from mica slate. At the northwest corner of the state, which is near the foot of the ridge in this place, the rock is very similar to some of that on the southwest mountain mentioned above. About a mile northwest of this *corner*, the rocks are cleft in several places, and in one, to such a depth, that the snow and ice remain here through the year. The *Snow Hole* (M) is about thirty feet long, and nearly as deep at the east end, ascends to the west, or towards the summit of the ridge, and is from ten to twenty feet wide. When I visited it in June, the snow was six feet deep on ice of unknown depth. The rock is here passing into *argillaceous slate*; and in many places it becomes *argillaceous* and *chlorite slate*. For the other rock, you have, I believe, proposed the name *talcose slate*.

3. *Quartz.* Though quartz is scattered through all the preceding rock in masses of different sizes, it is found in great quantity on the northeast part of Saddle Mountain, 300 or 400 feet above the college, and thence to the Hoosack along the side of the hill (L.) It is granular, often white and translucent, and often coloured with oxyd of iron. It forms *Stone Hill*, (N) a mile southwest of the college, on the vertex of which is argillaceous slate. This hill slopes to West Brook, where quartz often forms perpendicular banks from 50 to 100 feet high. Here also argillaceous slate rests on the quartz, as well as on the vertex, and on the east side of Stone Hill. Quartz appears again on the opposite side of West Brook, but further north, on a hill connected with the Taconick range. On these two hills, it lies in large strata, inclining, like the mica slate, to [341] the east and northeast, often divided by veins into rhomboidal masses. On the east side of Stone Hill, it is more granular, and may perhaps be called *arenaceous quartz*, containing a larger proportion of iron. Near the base of Hoosack Mountain, similar quartz is found, which extends round the north side of the Hoosack to Oak Hill, (D) which is wholly composed of it. It lies in rounded fragments, called *hardheads*, through the northern part of the valley, and on the sides of Oak Hill in huge rocks, presenting nearly perpendicular fronts from 20 to 50 feet in height, and many rods in length. The strata are in some places horizontal, and in others nearly perpendicular. In one place it forms plates, from 2 to 5 feet on a side, and from half an inch to several inches in thickness, which are nearly perfect rhomboids, the edges never being perpendicular to the sides. Most of the quartz, except the white, yields a small portion of lime, and has been called *calcareous quartz*. *Greasy quartz*, *rose quartz*, hornstone, and *rock crystal*, are occasionally found; the last in considerable quantity south of Stone Hill. On the stream which issues from the *Hopper*, is arenaceous quartz of a slaty structure, which is an excellent stone for sharpening the *chisels* used by *stonecutters*.

4. *Granular Limestone* is abundant at the *Cave* or *Falls*, in Adams, and on both sides of the Hoosack. The *Cave* or *Falls*, (O) is a singular chasm between limestone rocks. A small stream,

which appears once to have run on the surface of the hollow between two small elevations, has now worn a passage many feet in depth through the limestone. The chasm is narrow, winding in its course several rods long, and its opposite sides were connected, till four years ago, by a natural bridge of limestone. From the bridge to the water is 70 feet. There is a dark cavern of several feet diameter, and some passages into the rocks. The white marble walls, the foaming of the water below, the piles and irregularity of the rocks, and the thick overhanging trees, make the scene very wild and interesting. The limestone rests on mica slate. On the west bank of the Hoosack, and east base of the hill, (L) the same coarse-grained and white limestone is found, [342]
resting on the mica slate at the west of it.

At the north and west base of Saddle Mountain, (E) and at a less elevation than the quartz, are extensive strata of limestone, inclining the same way as the mica slate of the mountain. It is less distinctly granular, and less white than the other, but belongs to the same rock. It forms tolerably good marble. Between the strata are crystals of carbonate of lime, rhomboidal, and tending to the *lenticular* form. Some of these strata appear to be composed of blended crystals of this kind. In one place are strata of several rods in length and breadth, which are inclined to the southwest, and thus lie against the mica slate of the mountain. The inclination is about forty-five degrees. Unless this limestone be connected with that on the east of Saddle Mountain, (and no connexion has yet been traced,) it must be considered as lying on both sides of the mica slate, or alternating with it.

5. *Argillaceous Slate* rests on quartz on Stone Hill, and is also found low down in the valley connected with limestone. It constitutes the hill (P) connected with the Taconick range, and also Northwest hill, (Q) whose base is compact limestone. A few miles north, this slate is distinctly marked, and in about 12 miles, forms hills of *roof slate* in Hosack, New-York. It is annually carried in large quantities to Albany. On the first-mentioned hill, it contains some *talc*.

6. *Aluminous slate.* This is found in argillaceous slate, in Pownal, 5 miles north, at the base of a hill east of the Hoosack. It is used to *set* colours.

7. *Chlorite.* In rounded masses, generally with quartz, scattered through the valley in Williamstown, and found at an elevation of some hundred feet on the hills of the Taconick range. Chlorite slate has already been mentioned as occurring on the same range.

8. *Rubble Stone.* In rounded masses through the valley.

9. *Compact Limestone.* In several places low in the valley. Near the college it is white and deep gray. In the veins of the latter, *talc* is diffused in all directions. It contains silex, often from 3 to 15 per cent., and sometimes gives fire with steel. In some cases it is earthy. On Green River, one [343]
and a half mile south of the college, it lies in thin strata, which are divided by seams into very regular rhomboidal plates of various sizes. On some scattered fragments on this river, are found carbonate of lime in crystals, with pieces of white feldspar. On West Brook, this gray limestone is traversed by a vein of quartz, containing sulphuret of iron. The strata of this rock are almost invariably inclined to the east. A coarse *soapstone* is found in the limestone near the college, and a vein made up of brown argillaceous slate, soapstone, quartz, and sulphuret of iron, passes through it. This limestone appears to be very different from that at the base of Saddle Mountain, and from that which yields the marble of Berkshire county. It may still be *primitive*, but *primitive compact limestone*.

10. *Granitell* of Kirwan, *Quartz*, and *Feldspar*. This aggregate forms extensive strata at the east base of Stone Hill. The feldspar is diffused in grains through the quartz, and sometimes crystalline, forming *porphyritic quartz*. This aggregate is often compact and very hard, but frequently it is porous and hard, forming good millstones. Sometimes the quartz appears in such fragments, that the stone resembles *breccia*.

11. *Black Tourmaline.* In beautiful small six-sided prisms, in scattered pieces of mica slate at the base of Stone Hill.

12. *Amianthus.* Only a small specimen, attached to *argillaceous slate*.

13. *Bitter Spar.* On compact limestone at West Brook. Some of the crystals are rhomboids, and some appear to be the half of rhomboids split through their longer diagonal.

14. *Jasper.* The common brown or red, and black, in small rounded masses, and also a piece of variegated or striped jasper.

15. *Galena.* Only a specimen in the limestone on West Brook.

16. *Iron Ore. Bog ore* on the Hoosack, a mile northeast of the college. *Yellow earth*, from which *yellow ochre* is obtained in great quantity, in a hill (R) on the bank of Green River, 2 miles south of the college.

At the north end of Saddle Mountain, but low down, yellow earth is connected with *reddle*, or a [344]
substance much resembling it. It is less hard than the common reddle, but is composed of the same ingredients.

Magnetic Oxyd of Iron, regular octahedrons, in mica slate at the base of Stone Hill.

Supersulphuret of Iron, massive and crystallized, in argillaceous slate, mica slate, compact limestone, and quartz.

17. *Prase.* Beautiful, and containing sulphuret of iron; lately found by Mr. Eaton, a little east of the summit of Hoosack Mountain, in Florida.

18. *Puddingstone.* Where Pownal Mountain reaches the Hoosack, (T) 3 miles north of the

college, are some hills of this aggregate. It is composed of rounded masses of quartz, chlorite, and limestone, of various sizes, connected by an argillaceous cement.

19. *Potters' Clay.* Excellent for vessels of common pottery.

The minerals of this section, it is obvious, are not very important; but as connected with a transverse section of the country, they possess considerable interest. For this reason they have been particularly mentioned.

In the north part of Williamstown is a *mineral spring*, familiarly called the *Sand Spring* (S.) The water rises from several places in a reservoir of about a rod in diameter, and from one to three feet deep. It is very soft and warm, but contains very little saline or earthy matter. Gas continually rises in it. It appears much to resemble the spring at New Lebanon, New-York, and has proved useful in the cure particularly of some *cutaneous* diseases.

The *transverse section*, connected with the map, passes over Stone Hill, and the north part of Saddle Mountain. The different rocks are shown in the section, directly below their places on the map, by drawing lines from the several strata parallel to the sides of the map. This section is connected with that given by Mr. Hitchcock, in the 2d number of this Journal. It ought perhaps to be mentioned, that according to Mr. Eaton's account, the granite of this section sinks under [345] gneiss to the east, and rises again in Hampshire County, "supporting the same rock of gneiss;" but where it reappears, the granite contains "many imbedded minerals." This section corresponds generally to the place and character of the minerals in any section across Berkshire county. There are, however, some peculiarities which may be mentioned at a future day. The colouring corresponds to that on the geological map in Cleaveland's Mineralogy.

C. DEWEY.

Williams' College, Jan. 27, 1819.

P.S. I have a part of a *rock crystal*, which contains, in a hollow, a *liquid* and a *little air*, and some *black* or *brown particles*, which just sink in the liquid. It was found several years since at Diamond Hill in Catskill. This hill is only a small eminence on the bank of the creek at that place, composed of limestone, (if I have been correctly informed,) between the strata of which, and on the side next the creek, this and other rock crystals were found. I believe, Sir, you have one like the above, obtained from the same place. The crystal, which was generously given me by Mr. Van Loon, who found it, is only a part of two crystals connected at their bases. Partly under one of the solid angles formed by the united pyramids, is the hollow, about ⅝ inch long, about ⅜ filled with the air, and about ¼ inch wide. The principal curiosity about it is the liquid. It has never been known to *freeze*. It was exposed yesterday morning an hour to an atmosphere 4 and 5 degrees below zero. It became less fluid, for the bubble of air moved with less ease and rapidity. Still the liquid was fluid. Its colour, which is naturally white, had a slight tinge of yellow. The Rev. Mr. Schaeffer of New-York supposes the black particles are bitumen. Is it possible the liquid is *naptha*? This oil is sometimes colourless, and does not congeal at zero, and that which I distilled from the Seneca oil, does congeal at some degrees below zero. It can hardly be *salt water*, unless it be *very salt*, and even then, it would have congealed at the temperature of the air yesterday. What way can be devised to ascertain what it is?

Jan. 30, 1819.

After seeing the notice of the crystals found at Hudson by Mr. Schaeffer, I wrote to a member [346] of the Lyceum of Natural History, New-York, rather more full an account than the above, of my crystal, &c. I hope to ascertain, whether the liquid will congeal at 10 or 20° below 0, but have some fear lest the crystal should be injured.

C. D.

Art. IV. *On the Tourmalines and other Minerals found at Chesterfield and Goshen, Massachusetts, by Col.* George Gibbs.

(For the American Journal of Science.)

The schorl of the mineralogists of the last century united a variety of substances which subsequent observations have separated into several species. The green schorl is now the epidote, or the Vesuvian, or the actynolite. The violet schorl, and the lenticular schorl, are the axinite. The black volcanic schorl is the augite. The white Vesuvian schorl is the sommite. The white grenatiform is the leucite. The white prismatic is the pycnite, a species of the topaz, and another is a variety of feldspar. Of the blue schorl, one variety is the oxyd of titanium, another the sappare, and another the phosphate of iron. The schorl cruciform is the granatite. The octahedral schorl is the octahedrite, or anatase. The red schorl of Hungary, and the purple of Madagascar, are varieties of the oxyd of titanium. The spathique schorl is the spodumen.

The black schorl, and the electric schorl, only remained, and to avoid the confusion created by the use of the term schorl, the name of tourmaline was given to this species by that celebrated mineralogist, the Abbé Haüy.[50]

The tourmaline is found of almost every colour, and this variety of colour caused at first a [347] number to be formed into new species; which are now considered only as varieties of the tourmaline: such as the rubellite, the tourmaline apyre, and indicolite.

The different analyses of the tourmaline, however, affords a greater variety of results than is known in almost any other mineral.

The specific gravity of the	black varies	from 3.08 to 3.36
	Green	from 3.15 to 3.36
	Red	from 2.87 to 3.10

Analysis gives	Silex from	35 to 58
	Alumine	20 to 48
	Magnesia	0 to 10
	Iron	0 to 23
	Manganese	0 to 13
	Alkali	0 to 10
	Water	0 to 4

These differences must be in some measure ascribed to a defect in the accuracy of some of the analyses. But it appears that iron has not been discovered in the red tourmaline. It is not unworthy of notice, that the red tourmaline is considered as infusible, but the others fusible.

The red tourmaline has been the most valued, from its scarcity, its employment in jewelry, and the beauty of its crystals. It has been discovered in Siberia, in Moravia, in the East-Indies, and in Massachusetts. In Siberia it is found in a vein of decomposed feldspar in a fine-grained granite, with black tourmaline. In Moravia with quartz and lepidolite (or rose-coloured mica) in gneiss. In the East-Indies, at Ava and Ceylon, but its geological situation is not known, though it is probably in gneiss or granite.

The red or rose tourmaline of Massachusetts, is found chiefly at Chesterfield, in a subordinate bed of granite, contained in mica slate. The mica slate is the predominant rock of the country. It is fine grained, and contains an abundance of small garnets. Direction of the strata north and south, varying a little easterly; inclination perpendicular. The bed of granite is about three hundred feet long, and from five to twenty feet broad. It is contained in a narrow ridge of mica slate, which descends into, and is lost in, a valley. The sides are precipitous; the highest part is about forty feet high. On the east side a considerable part of the granite has been destroyed by natural causes, leaving the granite bare. The granite consists chiefly of granular feldspar, with grains of white quartz, and a little light coloured mica, is moderately fine grained, and of a grayish white colour. In addition to tourmaline, it contains also emerald, some of the crystals of which are from three to five inches in diameter. I succeeded in getting one out of its matrix, which is three and a half inches in diameter, and its summit (which is a plane without any additional facettes) is perfect. [348]

The tourmalines are contained chiefly in a false vein of silicious feldspar and quartz, which begins in the centre of the upper edge of the bed of granite, and passes obliquely, descending to the northeast, about twenty feet, where it is intercepted from sight by the mica slate. The vein is about one and a half foot thick in the upper part, and not more than six or eight inches where it is lost. This vein of silicious feldspar contains also a vein of bluish white transparent quartz, which is from three to eight inches thick, and passes through the centre of the vein of feldspar.

When I first examined this rock, soon after its discovery by Dr. Hunt, of Northampton, I determined the feldspar to be a new variety, which has been since confirmed by Professor Hauffman, and now ranks as a new sub-species, under the name of silicious feldspar. (P. 41, of the Mineralogical Table.)

The analysis of Professor Stromeyer, of Gottingen, gives, [349]

Silex	70.68
Alumine	19.80
Soda	9.05
Iron, Mag. and Lime	.38
	——
	99.91

The chief difference between this and the adularia is, that one contains fourteen potash and the other nine soda. Between this and the saussurite, or tenacious feldspar, the one contains eleven of lime, and the other only a trace.

The silicious feldspar, which I suspect to be the basis of the granite, crystallizes in thin rhomboidal tables. They are very frangible, and have one clivage perpendicular to the faces of the tables. Sometimes the tables have one lateral edge or more truncated. In one fragment of a crystal I observed a very obtuse acumination on the table, which appeared to be diedral, the sides being placed on the obtuse lateral edges of the tables. On account of the extreme frangibility of the crystals, it is certainly extremely difficult to seize their characters. Specific gravity only 2.333, probably owing to interstices between the tables. The colour is white, translucid, passing to semi-transparent; lustre sometimes dull, at others shining. The tables are sometimes so aggregated that their edges being exposed, offer wedge-shaped and stelliform figures. The tourmalines are chiefly contained in this vein. They are red, or green, rarely blue or black.

The green tourmalines vary from one-eighth of an inch to one inch in diameter; they are sometimes four inches in length, and are entirely confined to the inner vein of quartz. They are triedral prisms, with convex faces, striated longitudinally, and generally traversed perpendicularly to the axis, with very small fissures filled by some silicious substance, probably feldspar. These green crystals are opaque. The red tourmaline is frequently enclosed in the green. In certain parts of the vein almost every green crystal encloses a red one, which always corresponds by its sides and angles with the exterior crystal. Sometimes a thin layer of talc [350] intervenes between the outer and inner crystal. In one specimen I found three crystals of the red aggregated together, and enclosed in one of the green. In another crystal I found pyrites in the place of the red tourmaline. The largest crystal of the red was one quarter of an inch in diameter, and four inches long. The red tourmalines vary in intensity of colour, and frequently (particularly in the interior) pass into violet. They pass from translucid to semi-transparent. I have found some that were terminated by triedral pyramids. The crystals are generally perpendicular to the sides of the vein. Small crystals of the red often run from the vein of quartz into the adjoining feldspar. The granite also contains minute crystals of dark and light blue tourmaline, and pale green emerald, with a very few garnets and pyrites. In the lower part of the vein, five to six feet from its interruption by the mica slate, the red tourmaline scarcely appears, and the vein contains chiefly bluish amorphous quartz and green tourmaline. It is therefore probable that this vein will not afford henceforward a great supply of this beautiful mineral.

About six miles from Chesterfield, in Goshen, is found the rose mica, with tourmalines and emeralds interspersed in the granite. Unfortunately the bed of granite has not been discovered, and the specimens we possess are taken from loose rocks, scattered over a small extent of ground in a valley, in the neighbourhood of mica slate. The rose mica is found in a large grained granite with amorphous quartz and silicious feldspar, crystallized and amorphous. The mica is generally of a rose red, sometimes yellowish green. It crystallizes in rhomboidal tables, rarely truncated on the acute angles, passing into the hexaedral table. The tourmalines are light and dark green and blue, of various shades of intensity, frequently acicular and stellated. The black, the red, and the violet tourmalines also occur, but more rarely. Sometimes the green prisms enclose others of blue and black. Specific gravity of these varieties from 3. to 3.1. The green and blue crystals in this locality are translucid or semi-transparent. The feldspar is generally white, rarely light blue. There are some emeralds in the granite. Among some specimens which Mr. [351] Weeks of New-York, who discovered this locality, was so good as to give me, I found a beautiful rose emerald in its matrix. It is a hexaedral prism, about one and a quarter inch in diameter, the summit a plane, one of the lateral edges has a truncature. About half of the diameter of the prism is free from the matrix, and half an inch of the prism. The colour is a pale rose, rather more transparent than the emerald.

The colour of the mica of the Goshen granite calls to mind the lepidolite or lilalite, which (formerly considered as a distinct species) has now been united to mica. The lepidolite of Rosena is also accompanied by the tourmaline apyre, now the red tourmaline.

Art. V. *Observations on the Minerals connected with the Gneiss range of Litchfield county, by Mr.* John P. Brace, *of Litchfield, Conn.*

The gneiss formation is the most extensive of any in Litchfield county, and embraces a number of very interesting minerals. It extends east into Hartford county. On the north it runs into Massachusetts, though frequently interrupted by the limestone formation, which rests upon it. It forms the principal, and in many cases the only rock of the eastern and northeastern sections of the county, and of the towns of Litchfield, Goshen, Warren, Cornwall, and Norfolk. In Washington and Canaan, it constitutes the rock of the high mountains, and is a part of the same range in the other towns, while the valleys and the more moderate elevations are covered with limestone.

The river Housatonic appears to have made its way through this range, for the same rock continues on the western side of the river parallel to it in the mountains of Kent, Sharon, and Salisbury. In Litchfield commences a range of porphyritic granite, or *porphyritic gneiss*, which alternates with the common gneiss, and in some instances rests upon it. This rock begins at [352] Mount Prospect, between Litchfield and Warren, and runs through South Farms, Bethlem, and Watertown. The crystals of feldspar in it, are often very perfect.

The primitive granite, as a rock, is not found, though it lies scattered on the surface in great quantities, and large masses. The graphic granite in this region is often remarkably fine. Mica slate constitutes a considerable part of those rocks that rest on the gneiss, though never found in such elevated situations. The mica slate rocks are always inclined at a great angle with the horizon, and follow the direction of the other range. Litchfield village, Chesnut hill, and great part of Harwington, are entirely composed of this rock. The Bantum and the Waterbury rivers have their bottoms of it. Some of the brooks entering the Waterbury, have cut their passage through the mica slate, leaving walls of 40 or 50 feet on each side, traversed by veins of a very coarse-grained granite, and often much mixed with sulphuret of iron. The slate near Harwington meeting-house contains a great quantity of sulphuret of iron. Mica slate likewise lies on the sides of the gneiss range in Canaan and Salisbury, where it dips under the limestone. *Sienite* is scattered on the surface in large masses, especially where the porphyritic gneiss is found. Sometimes, however, the masses are so large as to form mountains. Mount Tom, between Litchfield and Washington, is of this nature, being entirely composed of sienite, resting on gneiss.

Slaty sienite is frequently found, having a very large proportion of hornblende.

The minerals that are found in this region, are much more interesting than its geology. In describing them, I shall confine myself to the district east of the limestone range, intending at some future time to investigate and describe the limestone country.

Carbonate of lime, the granular limestone, is scattered over the whole of this region. It often is found in the cavities of decayed quartz rocks, and contains tremolite and augite.

Cyanite or *Sappar*, is found in great quantities, especially in Harwington and Litchfield. A crystalline mass of this was found a few years ago, weighing probably 15 cwt.; it lay on a mica [353] slate ridge, and undoubtedly had been formerly imbedded in the slate. Beautiful white talc, and small crystals of sulphuret of iron, are disseminated in the mass. Specimens of this mass are in almost all the cabinets in America. Smaller masses have been found associated with feldspar. Small crystals of this mineral are very common in mica slate, with staurotide and garnet. Two of these crystals are often arranged at right angles with each other. In Cornwall it is found in small crystals in the gneiss containing graphite.

Staurotide is very common and very beautiful. It is found principally in mica slate, and exhibits often the cross. It most generally is crystallized in four-sided prisms.

Quartz, of course, is common. Cornwall particularly is distinguished for the *smoky* variety. Ferruginous quartz is found in rolled masses in the whole of this range.

Petro silex, in rolled masses with ferruginous quartz, containing veins of *chalcedony* and *hornstone*, and geodes of quartz crystals, are common in Litchfield and Goshen. Sometimes these masses in the interior assume the appearance of Burrstone.

Common opal has been found in Litchfield, though rarely. It was part of a mass of ferruginous quartz, with indelible dendritic impression. It is very hard, and its fracture is conchoidal.

Mica is very common. It is found green, white, and perfectly black. It generally occurs in blocks of granite.

Schorl, in rounded crystals, is found in all the granite in this range; in radiating crystals on quartz; and in acicular crystals on mica slate. The large crystals are so brittle, that few of them can be obtained perfect. I once found it in Litchfield, near Plymouth, in prismatic crystals on earthy graphite.

Feldspar is very common and beautiful in all the towns. It is usually found in rhomboidal fragments, and has a fine lustre. It is blue, white, and red. Some of the granite of Torringford is very beautiful, being composed of white and smoky quartz, red feldspar, and green mica. In the porphyritic gneiss, feldspar is in six-sided prisms. One small crystal of adularia, well defined, has been found by E. Wilkins, Esq.

Beryl, both crystallized and massive, is often found in Litchfield in granite. Its colours are [354] green, greenish yellow, pale yellow, and brown. Its crystals are often very perfect.

Garnets are common in all the towns of this range.

Epidote. Very beautiful crystals of this mineral have been found in Washington, associated with feldspar. They are so rounded as to render it very difficult to discover their form. They have a very fine lustre, and are of an olive green; in Litchfield, in crystals with hornblende, and graphic granite, and in veins in sienite.

Perhaps no region can be found containing more beautiful *tremolite*. All its varieties occur; the fibrous of Litchfield and Bethlem is very distinguished. In Canaan, it is found containing crystals of sulphuret of iron. I do not speak here of the tremolite found in the limestone range.

Common asbestus exists in Washington and New Milford.

The white *augite* is a mineral found in this range; in Litchfield, in six-sided prisms very much flattened, on quartz, and carbonate of lime with tremolite. They sometimes occur several inches long.

The *lamellar* and *slaty* varieties of common *hornblende* are very common.

Radiated *actynolite* of a beautiful bluish green in Litchfield; in Canton of a brownish green.

Steatite is common, and is quarried in Litchfield. The varieties of *talc* are very common, connected with steatite, cyanite, and chlorite.

Chlorite in Litchfield, is found on quartz, with talc.

Porcelain clay in Litchfield in small quantities, and in Washington.

Graphite is found in Cornwall in great quantities. Its gangue is gneiss and sienite. It is lamellar, and has a metallic lustre; is easily obtained, and might be made useful. Epidote and cyanite are found with it.

Ores are not common. Oxides of iron, and sulphuret of iron are scattered over the whole range. Near Mount Prospect in Litchfield, sulphuret of iron in mass is in great quantities; and sulphate [355] of iron on the surface of the ground near it. A stone containing a few grains of *native copper* was found in Litchfield.

The red oxyde of *titanium* occurs in Litchfield sparingly. A very handsome specimen of the *reticulated oxyde of titanium*, was picked up. It was on mica, and the mica had an evident tendency towards the same form.

BOTANY.

Art. VI. *An Account of two North American Species of Rottböllia, discovered on the Sea-coast in the State of Georgia, by Dr.* William Baldwin, *of Philadelphia*.

Flowers in pairs, or two from each joint of the rachis, one neutral. The neutral, or imperfect flowers, pedicillate.

Rottböllia corrugata.

Culmo erecto, compresso, sulcato, glabro, ramoso: foliis longis angustisque: spicis sub-compressis, nudis super uno latere, solitariis et terminalibus, supremis approximatis: calycis bivalvis, valva exteriori transversè *corrugata* et longitudinaliter rugosa: corolla trivalvis.

Culm erect, compressed, sulcate, smooth, ramose: leaves long and narrow: spikes slightly compressed, naked on one side, solitary and terminal, approximating towards the summit: calyx 2-valved, the exterior valve transversely *corrugate*, and longitudinally wrinkled: corolla 3-valved. *Vid. Nuttall's North American Genera*, v. I. p. 84.[51]

Culm two to three feet high, with a very solid exterior, but *spongy* within, compressed, and [356]
deeply grooved on its inner angle the whole length between the joints. *Leaves* long, narrow, and acute, scabrous on the margin and midrib. *Sheaths* compressed, corresponding with the culm, shorter than the internodes, open, with membraneous margins. *Peduncles* short, clothed with a thin membraneous acute pointed sheath, which generally encloses also the base of the spike. *Spikes* two to three inches long. The flowers are arranged in alternate order, but occupy only one side of the rachis, as in the *R. dimidiata*. The neutral florets, or *clavate* pedicels, are joined *laterally* to the perfect flowers. Articulations of the rachis remarkably tumid, attenuated beneath, flat on the interior side, exteriorly convex, scabrous, and longitudinally striate. The exterior valve of the calyx, in the perfect flowers, is ovate, obtuse, very thick, cartilaginous, the inner margin inflected, and deeply marked on its outer surface with from three to five *corrugations*, with longitudinal ridges between them; the interior valve is smaller, of equal length, acute, ruled, coriaceous, smooth, and with the inner margin also inflected. The valves of the corolla are membraneous, ovate, acute, white, shorter than the calyx, the exterior one the longest. The neutral florets are sometimes male, but most commonly consist of nothing more than a 2-valved calyx, the valves equal, gaping, scabrous, and much smaller than those of the perfect flower. *Stamens* 3, very short. *Anthers* twin, yellow. *Styles* 2, rather longer than the stamens. *Stigmas* small, plumose, dark purple.

Discovered between St. Mary's and Jefferson, in Camden county, Georgia, on the 13th of July, 1813. *Inhabits* flat, moist pine barren. I have not seen it "on the sea-coast of Florida."

OBSERVATIONS.

It will be perceived that my description of this plant differs *materially* from that of *Mr. Nuttall*.
This has unavoidably arisen from *my* having attended to it in its living state, and from *his* not [357]
availing himself of the information which it would have afforded me pleasure to have communicated, had he done me the favour to have requested it, or informed me of his wish to publish an account of plants thus obtained. He has called the culm *solid*, leaves *rather short*, spikes *cylindric*, *axillary*, the flowers and rachis *entirely smooth*, pedicel of the neutral flower *emarginate*, outer valve of the hermaphrodite calyx *acute*, the valves of the corolla *obtuse*, and the styles *very short*. I have not been able to confirm the above *characters*, nor do I find them even in the dried specimens. Besides, he has omitted to inform us that the rachis is *naked on one side*. This is a most important and prominent *specific character*, the omission of which would necessarily lead to much doubt in identifying the species. What he means by stating that the "outer valve of the hermaphrodite flower is 3-valved," I cannot imagine, nor do I comprehend what is intended by an "exterior auxiliary valve, or neutral rudiment; nearly the length of the calyx." I have noticed in a single instance, connected *laterally* with the corolla of the perfect flower, two very delicate, narrow, acute pointed bodies, the length of the outer valve, and of the same quality and appearance; but these I have considered as accidental, and cannot perceive any thing about them like *neutral rudiments*. Nor can I consider the articulations of the rachis as "deeply excavated." They are, as already stated, flat on the inner side, and constitute from their *flexuous* form, position, and connexion with the pedicels of the neutral florets, an arch, in which the perfect flowers are situated.

Rottböllia ciliata.[52]

Culmo erecto, tereti, glabro, ramoso: foliis angustissimis, brevibus: spicis cylindricis super pedunculis teretibus longis, solitariis terminalibusquæ: calycis bivalvis, margine valva exteriori *ciliata*: corolla bivalvis.

Culm erect, terete, smooth, ramose: leaves very narrow, short: spikes cylindrical upon long [358] terete peduncles, solitary and terminal, calyx 2-valved, the margin of the exterior valve *ciliate*: corolla 2-valved.

Root perennial. *Culm* two to four feet high, *generally* ramose, solid, and terete, except that between the joints where the branches originate, it is grooved on the inner side, and often ciliate on its angles near the joints. The branches originate towards the extremity, commonly from two to three in number, each supporting a single terminal spike. *Leaves* very narrow, acute, comparatively short, those beneath much the longest, rigid, somewhat involute, and sharply serrulate towards the apex. *Sheaths* rather shorter than the *internodes*, open to the base, but closely embracing the culm. *Spikes* 3 to 5 inches long, the peduncles clothed with a very delicate acute pointed sheath, which embraces it so closely as almost to elude observation, varying much in length, but seldom extending to the base of the spike. Peduncles scabrous near the spike. *Flowers* alternate, the *male* or neutral florets situated on one side of the rachis. *Rachis* compressed, slender, flexuous, hairy on its exterior surface. Pedicel of the neutral florets also compressed, and hairy on its exterior surface. *Valves* of the calyx *nearly* equal, lanceolate, acute, coriaceous, polished, the inner margin of each inflected. The exterior margin of the outer valve finely *ciliate* towards the apex. *Valves* of the corolla lanceolate, acute, membraneous, nearly the length of the calyx. The male or neutral, are rather smaller than the hermaphrodite flowers. *Stamens* 3, very short. *Anthers* twin, purple. Styles 2, excerted, plumose, dark brown.

Discovered in flat pine barren on the north side of Satilla river, in Georgia, on the 21st of October, 1815.

GENERAL OBSERVATIONS.

These plants are unquestionably allied to *andropogon* in their mode of flowering, but have nevertheless sufficient *essential characters* to distinguish them. In *habit*, they appear but slightly similar. They differ *principally* from their congeners in the pedicellate character of their neutral [359]
florets. *The spikes are not axillary in either of them.* The branches are *axillary*, of which several sometimes originate from the same axil in the *R. corrugata*. Each spike, when fully evolved, is not only *pedicellate*, but the *pedicel*, or peduncle, is connected with a *culm* containing one, two, or more joints.[53] The culm is not compressed, nor the leaves long in the *R. ciliata*, as stated by *Mr. Nuttall*, who appears to have confounded the two species in these, and some other instances. The joints of the rachis in both are *fragile*, the joints of the culm in neither.

Another species noticed by Michaux, and included in all our books as the *R. dimidiata, L.* has long been familiar to the southern botanists. Whether this be the *dimidiata* found also on the sandy shores of India, or the *compressa* of the same country, as suggested by *Mr. Elliott*, or a species distinct from either, I am not prepared to determine. But I have collected this plant in the Bermudian Isles, at Rio de Janeiro, and Bahia, on the Brazilian coast, and lastly on the island of Flores, near one hundred miles from the mouth of the Rio de la Plata, as well as on the main in the Banda Oriental.

Art. VII. *Floral Calendar kept at Deerfield, Massachusetts, with Miscellaneous Remarks, by Dr.* Stephen W. Williams, *of Deerfield.*

To Professor Silliman.

Sir,

Any thing which has a tendency to elicit facts with regard to the climate of a country must be interesting. I believe that observations upon the time of the germination, foliation, florification, and fructification of plants, afford a much more correct criterion respecting climate than thermometrical, or other meteorological journals. They should be made at the same time in [360]
various parts of the country, and for several years in succession. I send you a Calendarium Floræ, with miscellaneous remarks, made in Deerfield, Massachusetts, during a part of the years 1811, 1812, and 1818, which, if you please, you may insert in your valuable Journal. Latitude of Deerfield, 42° 32′ 32″, longitude 72° 41′.

1811.

March 1. Blackbirds arrived.

15. Black ducks arrived. Bees out of the hive.

20. Early garden peas, lettuce, and peppergrass sown.

28. The woods were swarming with pigeons. Wild geese passed over.

The greater part of the month of March was warm and pleasant. The sugar-maple yielded its sap profusely for a few days, but the nights were so warm that much less than the usual quantity of sugar was made this year.

April 1. Frogs begin to sing. Peas and oats sown.

8. Buds of the lilac, (*Syringa vulgaris*) the small red rose, the elm, (*Ulmus Americana*) the apple, and the peas considerably swoln.

14. Dandelion (*Leontodon taraxicum*) in full flower.

20. Indian corn planted; a few garden seeds sown. Martins and bank swallows arrived. Leaves of the currant and gooseberry expanded. Weather for a few days past sultry and smoky.

21. Blue violet (*Viola cucullata*) in full flower. Shad-bush (*Aronia Botryapium*) in blossom. Flower-buds of the lilac swoln; likewise the flower-buds of the cherry, pear, and apple.

23. Blood-root (*Sanguinaria Canadensis*) in full flower.

25. Asparagus fit for the table.

26. Chili strawberries in flower; this plant begins to blossom early, and continues to flower late in the season. English cherry, black heart (*Prunus cerasus*) in full flower.

27. Garden violet (*V. tricolor*) in full flower.

April 29. Flower-buds of the peach expanded. Large white plum (*Prunus domestica*) in full flower. Winter pear (*Pyrus communis*) in flower. [361]

May 1. Red and white currants in flower.

2. Leaves of the Lombardy poplar (*Populus dilatata*) expanded.

3. English and field strawberries in blossom.

4. Butternut (*Juglans cinerea*) in blossom.

6. House flies arrived.

7. Apple-trees in full flower.

8. Lilac in full flower. Red-headed woodpecker arrived.

15. Rye (*Secale cereale*) beginning to head. Pleasant days and cold nights. Hard frosts for a few nights past.

18. Honeysuckle (*Azalea nudiflora*) in full flower.

19. Small red rose in flower. Choke cherry (*Prunus Serotina*) in full flower.

25. Common red clover (*Trifolium pratense*) in full flower.

26. Garden peas in full flower. Hummingbird arrived.

27. Night-hawks arrived.

30. Sugar-maple in flower.

June 2. Locust-tree (*Robinia pseudacacia*) in flower.

3. Field strawberries beginning to ripen. Piony in flower.

4. High blackberry (*Rubus villosus*) in full flower. Broad-leafed laurel (*Kalmia latifolia*) beginning to blossom.

7. Snow-ball, guelder-rose (*Viburnum opulus*) in full flower. Radishes fit for the table.

12. Our farmers begin to mow their first crop of grass in low land. Large white rose (*Rosa alba*) in full flower.

21. Red currants beginning to ripen in plenty. Blackberried elder (*Sambucus canadensis*) beginning to blossom.

27. Indian corn tasseling. Black raspberries beginning to ripen. Nodding lily (*Lilium canadense*) in flower.

29. Potato (*Solanum tuberosum*) in full flower.

July 1. Red raspberry (*Rubus strigosus*) beginning to ripen. Poppy (*Papaver somniferum*) in flower.

July 5. Chestnut-tree (*Castanea Americana*) flowering. [362]

6. Large red cherry (*Prun. ceras.*) fully ripe. String beans fit for the table.

Perhaps we never experienced a greater degree of heat in this part of the country than has been felt for three days past. A number of hives of honey have melted during the heat.

14. Cucumbers fit for the table.

15. Rye fit for the sickle.

16. Black whortleberries (*Vaccinium resinosum*) ripening.

19. Early potatoes fit for the table. Indian corn (green) fit for the table.

20. Jenneting apples ripe.

21. Choke cherries (*Prun. serotina*) ripe.

26. Gooseberries ripening.

August 1. Martins departed.

5. Barn and bank swallows collecting in millions, upon our islands in the river, to depart.

12. Blackberries ripe.

20. Thorn apple (*Datura stramonium*) in full flower. Elderberries fully ripe.

September 1. Common pear fully ripe. Rare-ripe peaches fully ripe.

6. Bergamot pears fully ripe.

17. Great grapes (*Vitis æstivalis*) fully ripe. Frost grapes (*Vitis cordifolia*) ripening.

21. Butternuts beginning to fall from the tree.

24. Our farmers busily engaged in harvesting their corn.

26. Butternut defoliating.

28. Elm beginning to defoliate.

October 2. Chestnut burrs opening. Tree defoliating.

8. Sugar-maple and sycamore defoliating.

26. Blackbirds arrived again. Squirrels in plenty in our woods, though chestnuts and walnuts are scarce. Butternuts plenty. Cider and apples in great abundance.

November 20. Wild geese returning to the southern regions.

[363]

1812.

March 21. Blackbirds, woodpeckers, and robins arrived. Wild geese passed over.

23. Bees out of the hive.

April 3. Black ducks arrived. Large flocks of pigeons passed over.

9. Flower-buds of the elm considerably swoln.

11. Skylarks arrived.

12. Frogs begin to sing.

13. Leaf-buds of the soft maple (*Acer rubrum*) much swoln.

13. Leaf-buds of the gooseberry much swoln.

16. Early garden peas sown.

19. Dandelion (*Leon. tarax.*) in full flower. Blue or meadow violet (*V. cucullata*) in flower. Leaves of the lilac beginning to expand. Our farmers busily engaged in ploughing for sowing.

23. Peas and oats sown, and Indian corn planted.

25. Swallows arrived, and whippoorwills begin to sing.

27. Leaves of the gooseberry, and willow (*Salix Muhlenbergii*) beginning to expand.

May 5. Martins arrived.

10. Asparagus fit for the table. Blood-root (Sang. canadensis) in full flower.

11. Chili garden strawberries beginning to blossom. Flower-buds of the lilac swoln.

12. Elm in full flower. Leaves of the meadow violet beginning to expand.

13. Garden violet (*V. tricolor*) in flower.

14. Field strawberries in full flower. Shad-bush (*Aronia botryapium*) in blossom.

15. English cherry beginning to flower.

19. Winter pear beginning to blossom.

22. Hummingbirds arrived. Large white plum (*Prunus domestica*) in full flower. Butternut beginning to flower.

23. Flower-buds of the peach (*Amydalus persica*) beginning to expand. Gooseberry in flower.

May 27. Apple-trees beginning to blossom. [364]

29. Early garden lettuce (*Lactuca sativa*) fit for the table.

30. Apple-trees in full flower.

31. Night-hawks arrived.

Vegetation has put forth more to appearance in three days past than in all the spring before. Nature seems to revive from a state of torpidity, from the warm and invigorating rays of the sun. The month of May has been more backward than the month of April, 1811. The observation of elderly people, that the month of April, old style, was never known to terminate without producing apple-blossoms, has by no means been verified this year, they being now (June 1st.) in full flower. The snow upon the mountains, thirty or forty miles back, is at a great depth; so deep, that on the warm day of the 29th our river rose a foot from its melting. Diseases of the chronic kind have been peculiarly severe for three months past. The gladsome return of the cheering warmth will probably renovate the enfeebled constitutions of many of our aged people.

June 1. House flies arrived.

5. Choke cherry (*Prun. serotin.*) in full flower. Honeysuckle apple (*Azalea nudiflora*) in full flower.

8. Piony in full flower. Snowball (*Viburnum opulus*) in full flower. Flower-de-luce (*Iris versicolor*) in blossom.

11. Early peas in blossom. Carraway (*Carum carui*) in flower.

15. Locust-tree (*Robin. pseudacac.*) in full flower. Field strawberries beginning to ripen.

18. Common red clover in full flower. Cranesbill (*Geranium maculatum*) in blossom. Red raspberry in full flower.

23. Chili strawberries beginning to ripen. Garden sage (*Salvia officinalis*) in full flower.

29. Our farmers busily engaged in haying.

30. Large red rose, large white rose, and damask rose (*Rosa damascena*) in flower.

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July 1. White pond lily (*Nymphæa odorata*) in flower.

4. Black elder (*Sambucus canadensis*) in full flower.

7. Early peas fit for the table. Red and white currants ripening.

8. Nodding lily (*Lilium canadense*) in flower.

11. Garden beans (*Phaseolus vulgaris*) in full flower. Chestnut in flower. Black raspberries ripening.

20. Early corn tasseled (*Zea mays.* Variety *præcox.*) Red raspberries fully ripe.

22. Whortleberries ripe (*Vaccin. resinos.*)

24. Cucumbers fit for the table.

28. Early potatoes fit for the table.

29. Rye fit for the sickle. Early garden squashes (*Cucurbita Melo-pepo*) fit for the table.

August 2. Jenneting apples ripening.

5. Early corn fit for the table.

8. Wheat (*Triticum hyburnum*) fit for the sickle.

28. Summer peas ripening.

September 4. Watermelons and muskmelons ripe.

5. Swallows departed.

6. Elderberries fully ripe.

11. Choke cherries and wild cherries (*Prunus virginiana*) ripe.

12. Yellow plum (*Prunus chicasa*) fully ripe.

15. Butternut beginning to fall from the tree.

16. Our farmers making their first cider.

22. Great grapes ripe.

October 2. Butternut and elm beginning to defoliate. Chestnut-burrs beginning to open.

9. Our farmers beginning to harvest their Indian corn.

1818.

March 11. Bluebirds arrived.

13. Woodpeckers, robins, and blackbirds arrived. Bees out of the hive.

March 14. Broad-leaved panic grass (*Panicum latifolium*) beginning to sprout on a southern exposure, while there is sleighing in the street. A solitary spathe of skunk-cabbage (*Pothos fœtida*) beginning to show itself on the same exposure. Leaves of curled dock (*Rumex crispa*) appeared in the same place. Maple-trees tapped for sugar. [366]

16. *Pothos fœtida* in full flower.

25. Black ducks arrived. Catkins of the poplar-tree (*Populus tremuloides*) expanded. Catkins of

the speckled willow (*Salix Muhlenbergiana*) expanded.

30. Wild geese arrived. Phœbe arrived.

It began to rain hard on the first of March, and continued raining two days and a half, which nearly carried off an immense body of snow which enveloped the ground. Our rivers, which were more firmly locked with ice than they had been before known for many years to be, rose above their usual bounds, and swept the ice with such rapidity down their channels as to destroy most of the bridges on Connecticut river, besides doing immense damage in other respects. Our meadows were nearly all under ice and water; and at that time a great explosion was heard in the north meadows, two miles from the street, similar to the noise of a cannon. It was occasioned by the throwing up of an immense quantity of frozen ground, which is a great curiosity. The cause is not yet satisfactorily explained. The weather was very warm and pleasant from the 4th to the 22d. What snow the rain did not carry off was melted by the sun during the pleasant weather. Vegetation had begun to put forth rapidly, and many of our birds of passage had arrived. A storm, which commenced on the 22d, as rapidly retarded the progress of vegetation as it was before accelerated, and the remainder of the month was gloomy and uncomfortable. Mud mid-leg deep in the streets.

April 7. Flower-buds of the elm (*Ulmus americana*) beginning to swell.

April 8. Leaf-buds of the lilac (*Syring. vulg.*) beginning to swell. [367]

10. Leaf-buds of the soft or meadow maple (*Acer rubrum*) beginning to swell. Black alder (*Alnus serrulata*) in flower. American hazel (*Corylus americana*) in flower, and its catkins appearing.

11. Fair and pleasant, after a long storm. It has rained sixteen days in succession. Frogs begin to sing. Leaf-buds of the English cherry (*Prunus cerasus*) black heart beginning to swell. Garden peas sown.

12. Flies in myriads arrived in our streets. Catkins of the butternut (*Juglans cinerea*) beginning to swell. Saxifrage (*Saxifraga virginiensis*) in flower.

13. Skylarks arrived.

14. Sweet fern (*Comptonia asplenifolia*) in flower. White birch (*Betula populifolia*) in flower.

16. Our farmers beginning to plough for spring wheat.

18. Bank swallows arrived.

19. Leaf-buds of the currant, the gooseberry, and the apple, considerably swoln.

20. Dandelion (*Leon. tarax.*) beginning to flower. *Viola cucullata* beginning to blossom.

22. Our farmers ploughing for peas and oats. The snow upon the hills 20 miles north and west from Deerfield is two feet and a half deep, and the winds from those quarters are so chilly as to retard the progress of vegetation. Icicles scarcely melted upon the south side of buildings in Halifax, Vermont; and it is too cold for making sugar.

25. Blood-root (*Sanguinaria canadensis*) in flower on a warm south side hill. Leaves of the English gooseberry beginning to expand. Venus's pride (*Houstonia cœrulea*) in flower. Early life-everlasting, (*Gnaphalium plantagineum*) crowfoot, (*Ranunculus fascicularis*) tooth-root, (*Dentaria laciniata*) and meadow-rue (*Thalictrum cornutum*) in full flower.

26. Trailing arbutus (*Epigaea repens*) in full flower. Leaves of the barberry (*Berberis vulgaris*) beginning to expand. Five-finger, (*Potentilla pumilla*) adder's-tongue, (*Erythronium dens-canis*) liver-leaf, (*Hepatica triloba*) and wind-flower, (*Anemone nemorosa*) in flower. [368]

April 27. Early potatoes and early corn planted. Elm in full flower.

29. Water crowfoot (*Ranunculus sceleratus*) and American cowslip (*Caltha palustris*) in full flower.

30. Daffodil (*Narcissus pseudo-narcissus*) and rue-anemone (*Anemone thalictroides*) in flower.

May 1. Soft maple (*Acer rubrum*) in flower.

2. Martins arrived.

3. Leaves of the gooseberry beginning to expand.

4. Leaves of the currant and lilac beginning to expand. Pigeons arrived.

5. Wood bulrush (*Juncus sylvaticus*) in flower. A great freshet in our meadows, from the melting of the snow upon the mountains, and from the great rain which has continued nearly a month. Beth. nodding trillion (*Trillium rhomboideum*) in flower.

7. Flowers of the garden violet (*V. tricolor*) beginning to expand.

8. The young heads of asparagus breaking the ground.

9. Our farmers busily engaged in planting their Indian corn, though the weather is excessively cold. Sowed onions, parsnips, &c.

10. Bobylincolns (*Bob of lincolns*) arrived. Flower-buds of the lilac appearing.

11. Field strawberries (*Fragaria virginiana*) in full flower. Colts-foot (*Tussilago farfara*) in flower.

12. Whip-poor-wills begin to sing.

13. Spice-bush (*Laurus benzoin*) in full flower. A freshet in the meadows.

14. Goldthread (*Coptis trifolia*) in full flower.

15. Rattlesnake violet (*Viola primulifolia*) in full flower.

16. Chimney swallows arrived.

17. Leaves of the apple-tree expanding. Sugar maple (*Acer saccharinum*) in full flower. Garden daisy (*Bellis perennis*) in full flower.

May 18. Asparagus fit for the table. [369]

19. Smooth gooseberry (*Ribes uva-crispa*) in flower.

20. Shad-bush (*Aron. botryap.*) in flower.

21. House wrens arrived. Moose-wood (*Dirca palustris*) in flower.

22. Garden currant (*Ribes rubrum*) beginning to flower.

24. Wake-robin (*Trillium cernuum*) and peas (*Pyrus communis*) in flower.

25. Our mountain scenery diversified. Weather very warm. Garden potatoes and garden corn, planted on the 27th April, breaking the ground. Garden beans, cucumbers, squashes, watermelons, &c. planted.

26. Damson plum (*Prunus domestica*) and yellow or wild plum (*Prunus chicasa*) in flower. Elder (*Sambucus canadensis*) in flower. Carolina chatterer arrived.

27. Garden gooseberry (*Ribes grossularia*) and avens (*Geum rivale*) in blossom. Weather intensely warm. Thermometer at 86° at 2 o'clock, P. M. yesterday.

29. Apple-trees in full flower. Night-hawk arrived.

30. Choke cherries (*Prun. Serotin.*) in flower.

31. Lilac in full flower.

The weather till the last week in May was very cold and rainy. Perhaps we have never known more gloomy weather than that of the first twenty days of the month. The last week in the month of May was unusually warm and fine. Vegetation has put forth more within this week than it has in all the season before. The blossoms on apple-trees are scanty, and there is but little prospect of fruit. Peach-trees in the vicinity of this place were all killed by the extreme cold winter.

June 1. Hummingbirds arrived.

2. Honeysuckle apple (*Azalea nudiflora*) in full flower.

3. Blue-eyed grass, (*Sisyrinchium anceps*) *Krigia virginica*, and thorn-bush (*Cratægus coccinea*) in flower. Garden seeds, planted on the 25th ult. have vegetated 3 or 4 inches high. Garden rhubarb (*Rheum tataricum*) in flower.

June 4. Garden rocket (*Hesperis pinnatifida*) in flower. [370]

6. Yellow water lily (*Nuphar advena*) in full flower. Flower-de-luce (*Iris virginica*) in flower. Garden peas in full flower.

The weather for twelve days past has been unusually warm and sultry. The thermometer, much of the time in the middle of the day, has stood at 84°, and vegetation has put forth with astonishing rapidity.

8. House-flies arrived.

9. Horse-radish (*Cochlearea armoracea*) and peony in full flower.

10. Chives (*Allium schænoprasum*) in full flower.

11. Smooth stem lichnidea (*Phlox maculata*) in full flower. Our farmers busily engaged in hoeing their corn.

12. Fumitory (*Fumaria officinalis*) in full flower.

13. Field strawberries beginning to ripen.

14. Locust-tree (*Robinia pseudacacia*) in full flower.

15. Locusts appearing in the south part of the town. The last time of their appearance here was in the year 1801. Their periodical returns are once in seventeen years. Their appearance in the years 1733, 1750, 1767, 1784, and 1801, is recorded on the town-book. They first attack the leaves of the black oak (*Quercus nigra*.)

16. Small red rose in flower.

17. *Rosa caroliniensis* in full flower.

18. Garden sage (*Salvia officinalis*) in flower.

19. Mock syringa (*Philadelphus coronarius*) in flower.

20. Tulip-tree, commonly called cypress or white-wood (*Liriodendron tulipifera*) in blossom.

21. Carnation pink (*Dianthus caryophyllus*) in flower.

22. Our farmers commenced haying. An immense crop of grass on the ground.

23. Side-saddle flower (*Sarracenia purpurea*) in flower.

24. Common St. John's wort (*Hypericum perforatum*) in full flower.

June 26. Garden radishes fit for the table. [371]

27. Early garden peas fit for the table. Weather intensely warm.

28. American lime or linden-tree (*Tilia americana*) in flower.

30. Flax (*Linum usitatissimum*) in full flower. Thermometer in the shade at 2 P. M. 100°.

Vegetation has put forth and increased with a more astonishing rapidity this month than has ever been known. Notwithstanding the spring was very backward, the season now is forward. Our farmers commenced their first haying about a week earlier than they did last year.

July 1. White water lily (*Nymphæa odorata*) in flower.

3. Red and white currants ripening. Yellow day lily (*Hemerocallis flava*) and *Lilium canadense* in full flower.

4. Cucumbers and watermelons in flower. Early summer corn (*Zea mays*, variety *præcox*) beginning to tassel. Garden rue (*Ruta graveoleus*), mustard (*Sinapis nigra*), motherwort (*Leonorus cardiaca*) and mullein (*Verbascum thapsus*) in full flower. Blue whortleberries (*Vaccinium frondosum*) beginning to ripen. Dewberry (*Rubus trivialis*) ripening.

5. Poppy (*Papaver somniferum*) in flower.

6. Garden squashes (*Cucurbita Melo-pepo*) in flower.

7. Red raspberry fully ripe.

10. Black raspberry fully ripe.

11. String-beans fit for the table.

12. Unicorn plant (*Martinia proboscidea*) in full flower.

13. Thorn apple (*Datura stramonium*) and marygold (*Tagetes erecta*) in full flower.

15. Great water plantain (*Alisma plantago*) and field clover (*Trifolium arvense*) in flower.

17. Mad dog weed (*Scutellaria lateriflora*) and purple vervain (*Verbena hastata*) in blossom.

The weather for three weeks past has been excessively warm. The thermometer, for several days, has stood above 95°, part of the time at 98°. Our lands are now parching with drought. Our [372] grass fields are completely embrowned. Our farmers beginning to reap their rye.

July 19. Cucumbers fit for the table. Early corn (*green*) fit for the table.

21. Mother of thyme (*Thymus vulgaris*) in full flower.

22. Fig-wort (*Scrophularia marylandica*) and loosestrife (*Lysimachia stricta*) in flower.

24. Morning-glory (*Convolvulus sepium*) and *Orchis ciliaris* in full flower.

26. Whortleberries (*Vaccinium resinosum*) ripe. Single-seeded cucumber (*Sicyos angulata*) in flower.

28. Garden lettuce and hop (*Humulus lupulus*) in full flower.

30. Our farmers reaping their wheat—a tolerable crop. Buckwheat (*Polygonum fagopyrum*) in flower.

We had a great rain about the 20th, which restored the parched vegetation. The latter part of the month was, however, warm and dry.

August 1. Grasshoppers begin to sing. Crickets arrived.

2. Larkspur (*Delphinium consolida*) in flower.

3. Sunflower (*Helianthus annuus*) and pigweed (*Chenopodium album*) in flower.

6. Broom-corn (*Sorghum saccharatum*) and lavender (*Lavendula spica*) in flower.

7. Early jenneting apples ripe. *Ambrosia trifida* and American senna (*Cassia marylandica*) in flower.

11. Muskmelon ripe. Garden squashes and shelled beans fit for the table.

13. Seed-box (*Ludwigia alternifolia*) in flower. Garden gooseberries fully ripe.

14. Our farmers gathering their peas and oats—an indifferent crop. Weather warm and dry.

16. Martins departing. Bush clover (*Lespedeza capitata*) in flower.

18. Our farmers beginning to mow their second crop of hay. Jerusalem oak (*Chenopodium botrys*) in flower.

20. Houseleek (*Sempervivum tectorum*) in flower. [373]

21. Herb clarry (*Salvia sclarea*) in blossom.

22. Swallows collecting in thousands to depart. Toothed coral (*Cymbidium odontorhizom*) in flower. Saw bats for the first time this year.

24. Lopseed (*Phryma leptostachia*) and ladies' traces (*Neottia pubescens*) in flower.

27. Gay mallows (*Lavatera thuringiaca*) and *Solanum nigra* in full flower.

30. Burnet saxifrage (*Sanguisorba canadensis*) and water horehound (*Lycopus europæus*) in full flower.

STEPHEN W. WILLIAMS.

Deerfield, (Mass.) Jan. 25, 1819.

Art. VIII. *Description and Natural Classification of the Genus Floerkea, by* C. S. Rafinesque.

This genus was discovered in Pennsylvania, near Lancaster, by the Rev. Dr. Muhlenberg, who communicated the same to Wildenow of Berlin. This celebrated botanist ascertained that it was a new genus, to which he gave the name of a German botanist, (Floerke) and published it in the third volume of the transactions of the society *des Curieux de la Nature* of Berlin, for 1801, under the name of *Floerkea proserpinacoides*, which long and uncouth specific name has been changed by every subsequent author. Michaux has omitted it altogether, (with many more American species) in his *Flora Boreali Americana*, published in 1803. Persoon calls it *Floerkea lacustris*, in Syn. plant. 1. p. 393. Muhlenberg *Floerkea uliginosa*, in Cat. pl. Amer. Sept. p. 36. and Pursh, in Flora Amer. Sept. 1. p. 239, unites it with the genus *Nectris*, and calls it *Nectris pinnata*, putting it therefore in the Hexandria digynia of Linnæus, while all the preceding authors had classed it in the Hexandria monogynia. I will show presently which among them appear to be wrong; but I [374] must notice before, that no botanist had, I believe, endeavoured to class it naturally, until Mr. Correa de Serra, who in his *reduction of American genera to the natural families of Jussieu*, attempted, without having had an opportunity to see the plant, to place it in the family of *Junci*, taking it therefore to be a monocotyle plant; being led into this error by a mistaken idea, that all hexandrous plants must be monocotyle! But in the spring of 1816, I found this plant in the neighbourhood of Philadelphia, (near the falls of the Schuylkill) where it had escaped the attention of all the botanists of that city, and in particular of Dr. William Barton, who has therefore omitted it in his Prodr. fl. Philad. and having communicated it to Mr. Correa, he acknowledged that it was dicotyle, of which fact I was aware, even before seeing the plant and dissecting its seed, by attending to its habit.

The following exact description of this genus will enable the reader to ascertain how far I am correct in my presumptions towards its natural arrangement.

Floerkea. Perigone double persistent, sixpartite; the exterior calicinal 3 partile, sepals acute; the interior shorter, coloured 3 partile, sepals petaloid, oblong, obtuse. Six stamens perigyne, filaments filiform, of the length of the interior sepals, anthers round. One free ovarium, rounded and bilobed, one central and bifod style, two capitated stigmas. Fruit a bilobed atricule, tuberculated and bilocular dispermous, sometimes round, unilocular and monospermous by abortion of one lobe and cell. Seeds attached to the centre near the bottom, nearly lenticular, smooth albuminous, easily divided in two lobes. *Habit.* Small, delicate, annual, and glabrous plant, with alternate polytome pinnated leaves, flowers axillar, solitary, pedunculated.

Floerkea uliginosa. Caule tenello flaccido erecto simplex, foliis 4 petiolatis imis ternatis, summis pinnato, quinatis, pinnulis lineari oblongis obtusis, integris floribus axillaris, solitaris pedunculis longis apice incrastatis. Stem delicate, soft, upright, and simple, leaves petiolated, the inferior ternated, the superior pinnated, quinate, pinnules linear-oblong obtuse, flowers axillar, [375] solitary, and on long peduncles, swelled under the flower.

Among the several specific names given to this plant, I prefer Muhlenberg's, as it expresses exactly the kind of situations where it grows, say in moist grounds, occasionally swampish or overflowed; those I found near Philadelphia, grew by thousands on the banks of a small brook in a wood below the left side of the falls of Schuylkill. Persoon's name of *lacustris*, being wrong, as it would seem to imply that it grows in lakes only; and Wildenow's name being too long and illusive, its similarity of habit with the genus *Proserpinaca* not being very striking. However, even the name of *uliginosa* is liable to some slight objection; and did I think myself permitted to coin a new name, while so many have been proposed already, I should have called it either *F. tenella*, or *F. flaccida*, or *F. olitoria*, being a very delicate and tender plant, and very good to eat in sallad, as I have tried it myself, its taste is sweet and pleasant, the whole plant may be eaten, (even the root) being all juicy and tender: it grows in such an abundance in some spots, that it might occasionally afford a most precious and delightful sallad, but if cultivated for that purpose, it might be found an agreeable addition to our culinary herbs.

In addition to my above definition, it will be proper to state that the stem of this plant rises from 4 to 8 inches, it is cylindrical, smooth, and yellowish, the middle leaves are the largest, the lower peduncles are longer than the leaves, and the upper ones shorter, the petals or interior sepals, and the stamens are yellow. It blossoms in May, and is annual, it even lasts only three months.

It will be perceived that I do not agree with Mr. Pursh, in uniting this plant with the genus *Nectris*: he owns himself that it deviates a *little* from the generic character of *Nectris*, but these deviations appear to me very material; they exist in the pistils and fruits, the most essential parts of the flowers, since they agree in the perigone and stamens. The genus *Nectris* (or *Calomba* of Aublet) has *two ovaries*, *two styles*, and *two polispermous capsules*, or *achens*! and belongs therefore to the second order *Perimesia*, (class *Eltrogynia*) eighth family *Achenopsia* next to the [376] genus *Myriophyllum*: while the genus Floerkea which has a *bilobed ovary*, *one central style*, *two stigmas*, and *one bilocular dispermous achen*, must belong to the eleventh order of the same class; *Isostimia*, which is characterized by having more than one stigma, the stamens in regular number, and not central; it will form a connecting link between this order and the foregoing *Polymesia*, by its affinity with many genera of the *Euphorbia's* tribe, such as *Callitriche*, *Tragia*, *Mercurialis*, &c. from which it differs merely by having hermaphrodite flowers, and perispheric regular stamens. It will at present stand nearly isolated in this order, where it may form the small family *Galenidia*, along with the genus *Galenia*, &c. and which shall have much affinity with the family *Phytolacia*; but this differs by having a multilocular berry, while the *Galenia* merely differs by having a 4 sided perigone, 8 stamens, and 2 styles.

I admit, however, that there is a strong affinity between the genera *Floerkea* and *Nectris*, but stronger affinities often exist in plants of different classes. If, however, it should happen that Aublet[54] might have been mistaken in describing the ovaries and capsules of the *Nectris* as double, if they should prove to be simple but bilobed, then the *Nectris* would belong to the same family as the *Floerkea*; but yet stand as a peculiar genus distinguished by having 2 styles, and the achens not monospermous!

It was insinuated to me by Mr. Correa, that the *Floerkea* might have some affinity with the tribe of *Ranunculaceous*, but I cannot discover any, since that tribe is widely different, by having many ovaries, stamens, and fruits, each ovary with 1 style or stigma, a deciduous perigone, the anthers adnate, &c. The analogy in the structure of the seed and habit, is too slight to be taken in consideration.

Art. IX. *Descriptions of Three New Genera of Plants, from the State of New-York. Cylactis, Nemopanthus, and Polanisia, by* C. S. Rafinesque. [377]

1. *N. G. Cylactis.*

Calyx campanulated 6 to 10 fidus, sepals a little unequal. Petals 4 to 6 equal. Many perigynous stamens. Pistils 8 to 12, ovaries sessile ovate, styles elongated, stigmas capitated. Berries few, distinct, one seeded.

This new genus belongs in the analytical and natural method, (see Analysis of Nature) to the first natural class *Eltrogynia*, first natural order *Rhodanthia*, second natural family *Senticosia*, next to the genera *Rubus*, *Oligacis*, &c. It would range itself into the artificial class *Icosandria* of the Linnæan sexual system; but not properly into any of its orders, since the number of pistils is variable, and never above 12. Only one species belongs to it, which I have discovered in company with Mr. Knevels, on the Catskill mountains. The etymology of the name derives from two Greek words meaning *radiated calyx*. It differs essentially from *Rubus* by the unequal many cleft calyx, variable petals, and few pistils.

Cylactis montana. Mountain cylactis—Stem herbaceous upright, unarmed, pubescent; leaves quinate, nearly smooth, upper ones sessile, stipules oblong, folioles ovate acuminate, incised, serrated, ciliated, base acute, entire, the middle one petiolated: flowers few corymbose, peduncles erect elongated bracteolated; calyx pubescent, sepals lanceolate acute, nerved, reflexed; petals cuneate-obovate, longer than the calyx.

It is a small perennial plant, rising about half a foot; flowers white, blossoming in June. On the Catskill mountains near the great falls, &c.

2. *N. G. Nemopanthus.*

Dioical. M. flowers calyx 5 phylle, equal, deciduous. No corolla. Stamina 5 hypogynous, alternating with the calyx. Fem. fl. calyx deciduous 5 phylle? Ovary ovate, stigma sessile 4 lobed. [378] Berry 4 celled 4 seeded.

The name means *flower with a filiform peduncle*. A shrub forms this genus, which had perhaps been united with *ilex* by Michaux, &c.; but it differs altogether from it by the want of corolla, hypogynous stamens, sessile, style, &c. it does not even belong to the same family, but to the natural family *Rhamnidia*, natural order *Plynontia*, and natural class *Eltrogynia*, next to the genus *frangula*. In the sexual system it would belong to *Dioecia pentandria*, very far apart from

Frangula.

Nemopanthus fascicularis. Fascicled nemopanthus. Shrubby, leaves fasciculated, petiolate, oblong, mucronate, entire, rather undulated, membranaceous, smooth; flowers axillary fasciculated, peduncles filiform, shorter than the leaves.

It forms a small shrub from 5 to 8 feet high, covered with gray bark, and with slender upright branches; the flowers are greenish, very small, the female flowers have shorter and thicker peduncles; they blossom in June. It grows on the Catskill mountains near the two lakes. It is, perhaps, the *Ilex canadensis*? of Michaux and Pursh. And it has some analogy with the *Frangula alnifolia*.

3. *N. G. Polanisia.*

Calyx 4 phylle, phylles coloured unequal, the upper one unguiculated spatulated. Corolla with 4 unequal petals, the two upper ones larger and unguiculated. A nectarium upwards glandular, broad, and truncated. Stamina 9 to 14, unequal, erect, hypogynous. Ovary oblong on a short pedicel, one style, one truncated stigma. Fruit a follicular capsule, one celled, two valved, many seeded, seeds inserted on each side of each suture, nearly snail-shaped.

The type of this genus is the *Cleome dodecandra* of Linnæus, under which denomination many species were blended, which have no similitude with the real genus *cleome*, differing in the calyx, corolla, nectarium, stamina, and fruit. I shall describe here that of North America, where 2 or 3 species exist, besides those of the West Indies, Africa, and Asia, which are totally different. The [379] etymology of the name which I have given to it, derives from *many irregularities*. It belongs in the analytical method of botany, to the first natural class *Eltrogynia*, ninth natural order *Monostimia*, natural family *Capparidia*. It can find no place in the sexual system since the number of stamina varies from 9 to 14, unless it be forced into *Dodecandria*.

Polanisia graveolens. Clammy polanisia—hairy and glutinous all over, stem upright, leaves alternate, petiolate, ternated, folioles sessile, the intermediate longest, oblong, obtuse, entire, hairy on the margin and nerves: flowers racemose erect, bracteas petiolate, ovate, obtuse, calyx hairy, petals emarginate, crenate, capsules divaricate glutinous.

It is the *Cleome dodecandra* of Michaux and Pursh. It grows on the banks of rivers and lakes, on the Hudson near Newburgh, on the Susquehannah near Harrisburg, on Lake Erie, on the Ohio, and Mississippi, &c. It blossoms in July and August, the stem rises about 1 foot, the petals are white, or slightly red. The whole plant has a strong graveolent smell, similar to that of *Erigeron graveolens*. (Received January, 1818. *Editor.*)

Art. X. *Notice on the Myosurus Shortii.*

I have the pleasure to announce to the botanists, that the genus *Myosurus*, hitherto thought an European genus, and composed of a single species, has been detected in the United States by Dr. Short of Kentucky, who has discovered it in the neighbourhood of Hopkinsville, in Christian county, West Kentucky, and has communicated me specimens of it; by which, on comparing them with the European *Myosurus*, figured in *Flora Danica*, Lamarck's Illustrations, &c. I have been enabled to ascertain, that the American plant must form a second species of that genus, which I have accordingly dedicated it to the discoverer, by naming it *Myosurus Shortii*. This adds another genus and another new species to our Flora. I add the comparative definitions of the two species, exhibiting; their different characters and diagnosis.

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Myosurus minimus. Lin. &c.	*Myosurus Shortii.* Raf.
Leaves linear-cuneate, broader near the top, and acute. Scapes as long as the leaves, thickened towards the upper part. Calix 5 leaved, Spurs consimilar: petals 5. Stamens 5 to 8. Carpophore as long as the scapes.	Leaves linear obtuse, hardly attenuated below. Scapes shorter than the leaves, and filiform. Calix 3 to 5 leaved, spurs membraneous: petals 3 to 5. Stamens 10 to 12. Carpophore shorter than the scapes.

C. S. RAFINESQUE.

Philadelphia, May 1, 1819.

Art. XI. *Description of a New Species of Gnaphalium, by Professor* E. Ives.

To B. Silliman, Esq. M.D., &c.

The following description of a new species of Gnaphalium, accompanied with a drawing, has been in my possession for two years. If the subsequent observations will be of use to correct error, or solve doubts which may have existed concerning some species of gnaphalium, they are at your service.

E. IVES.

This plant was first observed by me, in company with Mr. C. Whitlow, in July, 1817, by the margin of a brook, a few rods north of Mr. E. Whitney's gun manufactory, near New-Haven. It is also found on the margin of the Housatonick, about thirty miles from Long Island sound, where it was observed by Dr. Alfred Monson, the last summer. Specimens of this plant were sent to Z. Collins, Esq. of Philadelphia, for the purpose of comparing it with the species of gnaphalium in Muhlenberg's herbarium, more particularly with the *luteo-album* and *Pennsylvanicum*, which I had not seen.

Gnaphalium decurrens.

I am indebted to the politeness of Mr. Collins, for the facts on this subject relative to Muhlenberg's herbarium. He observes, "your Gnaphalium is certainly not the *luteo-album* of Muhlenberg, which may not strictly be a native, but introduced. Yours most approaches G. polycephalum Mx. Still, from the decurrent leaves and other differential marks, it appears to me to be a new species. Muhlenberg's collection has it not."

As the *luteo-album* is said to grow in New-England, yet so far as my observation has extended it has not been found by any of the botanists, I am induced to believe that this opinion has arisen from some erroneous description of the plant which is the subject of this paper.

As the decurrent leaves of this Gnaphalium distinguish it so obviously from all the other American species of Gnaphalium, I propose to give it the specific name of *decurrens*.

Specific description of Gnaphalium Decurrens (large life everlasting.)

Leaves lanceolate, broad at base, acute, decurrent, somewhat scabrous above, tomentose beneath; stem leafy branched spreading, about three feet high.—See the plate.—The plate represents a section of the upper part of the plant.

FOSSIL ZOOLOGY, &c.

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

If the following descriptions and notices of some of the animal productions of our country, chiefly fossil, and of which some are but little known, should be found of sufficient interest to occupy a place in the Journal of Science, they are very much at your service for that work.

The greater portion of them are extracted, with some modification, from an essay which I read [382]
about three years ago, to the Academy of Natural Sciences, without any intention at the time of giving publicity to them. But the rapid diffusion of a taste for geological research, seems to require corresponding exertions on the part of those who have attended to fossil remains, inasmuch as geology, in order to be eminently furnished with every advantage that may tend to the developement of many important results, must be in part founded on a knowledge of the different genera and species of reliquiæ, which the various accessible strata of the earth present. The accessory value of this species of knowledge, is now duly estimated in Europe, as affording the most obvious means of estimating, with the greatest approximation to truth, the comparative antiquity of formations, and of strata, as well as of identifying those with each other which are in their nature similar.

Certainly very little is yet known about the fossils of North America, and very little can be known accurately, until we shall have it in our power to compare them with approved detailed descriptions, plates, or specimens of those of Europe; which have been made known to the world by the indefatigable industry, and scientific research of Lamarck and other naturalists.

America is rich in fossils. In many districts of the United States, vast beds of fossil shells, zoophytes, &c. are deposited, which, for the most part, are concealed from the inquiring eye, offering superficially a mere confused mass of mutilated fragments. These rich repositories must finally be exposed to view, by the onward pace of improvement, and the more interior strata will be unveiled by some fortunate profound excavations, the result of enterprise in the pursuit of gain. The very surface of the country in many regions, is almost overspread with the abundance of casts, or redintigrate fossils, many of which are apparently specifically anomalous, and some generically so. The correct, and only useful mode in which the investigation of our fossils can be conducted, is attended with some difficulty and labour.

The task presumes the knowledge, not only of fossils in all their different states, from the [383]
apparently unchanged specimen, to the fragment or section of a cast uninsulably imbedded in its rocky matrix, but it also requires an adequate acquaintance with recent specimens, or those of which the inhabitants are not yet struck from the list of animated beings, in other words those of the present, as well as those of the former world.

Due advantage being taken of the many opportunities which are from time to time offered to us, of obtaining knowledge in this department, will probably be the means of producing a list of American animal reliquiæ, coextensive with that of Europe at the present day. In the present state of the science, however, the correct naturalist will feel it a duty which he owes to his colaborators to proceed with the utmost caution, that he may not add unnecessarily to the already numerous species.

Genus Alveolites, Lam.

Coral lapideous, covering extraneous bodies, or in a simple mass, formed of concentric strata; strata composed each of a union of numerous alveoles, which are very short, contiguous, reticulate, and generally parallel.

Species.

A. glomeratus, alveoles vertical, subequal, oval, or obsoletely hexagonal, much shorter than the diameter, parallel; paries simple; strata numerous, forming a rounded mass. (*Cabinet of the Academy of Natural Sciences.*)

Found often on the coast of North America, cast up by the waves, the animals sometimes still living. Forms masses of various sizes and figures, generally more or less rounded or lobed, and composed of a great number of concentric layers. The number of these strata seems to be regulated in some degree, by the quantity of surface they have to cover. Thus if the nucleus happens to be a small shell, such as the *Naticæ*, *Nassæ*, &c. of our coast, or even the oyster, (*O.
virginica*,) clam, (*V. mercenaria*,) &c. the strata are often very numerous; but on the thoracic [384]
plate of *Limulus polyphemus*, having a considerable space over which to extend themselves, the strata are but few, not more than 2 or 3. I have seen the thoracic plate of this animal so entirely covered by the *Alveolite*, as to have the eyes and stemmata concealed so as to be perfectly blind. When composed of a single layer only, it much resembles a *Flustra*, or a *Cellapore* of which the convex surfaces have been removed by attrition. The animal I have not yet examined. The alveoles or cells of a layer, are arranged in lines of different degrees of curvature, obscurely radiating from different centres; these lines are placed side by side, the alveoles alternating with each other throughout the layer in a quincunx manner; the thickness of the paries is somewhat equal to one half of the conjugate diameter of the alveole, the length of which, or thickness of the layer, is scarcely more considerable; but these proportions vary.

The species to which it seems allied, are *madreporacea* and *incrustans*. The former is fossil, and differs in being subramose; the latter forms but a single expansion.

Genus Favosites, Lam.

Coral lapideous, simple, of a variable form, composed of parallel prismatic and fasciculated tubes; tubes contiguous, pentagonal, or hexagonal, more or less angular, rarely articulated.

Species.

F. striata, more or less turbinate; *paries of the alveoles* longitudinally striated within, and fenestrate with minute osculi; *alveoles* with very numerous septæ. (*Cabinet Acad. Nat. Sciences; and Peale's Museum—common.*)

Found fossil in various parts of the United States, at the falls of the Ohio; Genessee, New-York; Pittsburg and Wilksbarre, Pennsylvania; Missouri, &c. &c. but not yet in the alluvial deposit of New-Jersey.

The tubes are generally, partially, or entirely filled with silicious matter, sometimes so completely so, as to resemble in miniature, basaltic columns; when the alveoles are free on the [385] surface, these fossils are known by the name of *petrified wasp-nests*, from the resemblance they bear to the nests of those insects. The silex is usually only infiltrated into the cavities, leaving the substance of the coral in its original calcareous state, but the specimens which are found amongst the rolled pebbles of the Delaware River, near Philadelphia, are completely silicified.

The size varies from one fourth of an ounce, to two hundred pounds or more, and the tubes occur of every intermediate diameter, from the fortieth to one fourth of an inch. It is not common to find any two specimens of like form, they are, however, ordinarily more or less turbinate, but are sometimes depressed or compressed, and the tubes rectilinear or excurved, and of various lengths. The dilated summit is not so much the effect of a gradual enlargement of the tubes, as of the frequent and adventitious interposition of young ones, which of course renders the openings of the tubes unequal. The tubes or alveoles, vary in the same coral, being 5 or 6, rarely seven sided, but the hexagonal form is most common; the interior of a tube is divided into a great number of apartments or cells, by approximate transverse septæ, each of the cells appears to be connected with the corresponding cells of the surrounding tubes, by lateral orifices in the dividing paries; these orifices are minute, inequidistant, orbicular, their margins slightly prominent, and forming from one to three longitudinal series on each side of the tube; each row is separated from the adjoining one by an impressed line. By means of these osculi it seems probable that all the animals inhabiting a common coral, were connected together, or had free communication with each other, but whether by means of a common organ as in *Pyrosoma*, *Stephanomia*, &c. or simply by contact as in the aggregating *Salpa*, &c. we have no means of determining.

The *striata* differs from *Madrepora truncata*, Esper. (*F. alveolata*, Lam.) in not being "extùs transversè sulcata." It seems to be allied to *Corallium Gothlandicum*, Amœn. Acad. v. 1. p. 106, and it is possible it may prove synonymous, or very similar to it, when that species becomes better known; the latter has been taken for Basalt, and M. Lamarck when describing it, inquires [386] "Est-ce un polypier?" *Madrepora fascicularis*, of Volck. and Parkin. in common with *F. striata* and *F. Gothlandicum*, is distinguished by the transverse septa, a character which induced me to refer the species here described to *Favosite*; they seem therefore to be congeneric, as analogy indicates a participation in the character of osculated paries.

Amongst the great variety exhibited by this species, we have to remark more particularly the following, viz.:

1st. Alveoles perfectly free, that is, destitute of aciculi or lamellæ, the septa wanting, and sometimes the osculi obsolete.

2d. Alveoles filled almost to the summit with the septa, and resembling those combs of the bee-hive which are filled with honey and covered over.

3d. Paries beset with very numerous, interrupted, alternating, transverse lamellæ, which are denticulated at their tips, and project towards the centre with various degrees of prominence and irregularity.

The first variety corresponds with the generic character, and the third approaches the genus *Porites*; yet so unequivocally identical are they, that I have seen them all united in the same mass, and perforated throughout by the osculi. The identity is further obvious by the perfect gradation which renders them inseparable.

With respect to the transverse septa, I think their presence may be accounted for by supposing that as the animal elongates its tube in consequence of an increase of growth, or in order to maintain an equal elevation with the adjacent tubes, (rendered necessary by the origin of young tubes in the interstices) it gradually vacates the basal portions of its tube, and sustains itself at the different elevations, by successively uniting the parietal lamellæ so as to exclude the vacuity. That this is probable, we may infer from a similar procedure on the part of several species of testaceous mollusca. Thus some Linnæan *Serpula* become camerated, and a familiar instance presents itself in the *Triton tritonis*, the animal of which adds successive partitions to the interior [387] of the spire, as that part becomes too strait for the increasing volume of its body. If the above supposition proves correct, the organs of communication which pass through the osculi, can hardly be in common, but must rather connect the animals by simple contact only, otherwise these parts would be broken when the animal changes its place by vacating the inferior part of the tube.

The third variety is then the state of that portion of the tube which is inhabited by the body of the animal, and not yet interrupted by the septæ.

From the above observations, it is evident that this species, and probably the entire genus *Favosite* under which I have placed it, will not arrange properly with the *Tubipores*, *Millepores*, &c. but must be transferred to the *Polypiers Lamellifères* of Lamarck. And if the *Madrepora retepora* of Solander and Ellis, is a true *Porites*, as M. Lamarck supposes it to be from the appearance of its tubes, I should conclude this genus to be very proximately allied to *Favosites*, by that species and the *F. striata* having in common the remarkable character of fenestrated paries. But to this character I should conceive a generic importance ought to be attached, as indicating a differential organization of the artificers. I have no doubt that on close inspection of a perfect specimen, the same character will be found to exist in *F. Gothlandicum*, and possibly also in *F. truncata*, if not in the latter only, it may be proper to separate the genus and to withdraw from *Porites* the forementioned species, retaining to *striata* as specifically essential, the second member of the differential description.

(*To be continued.*)

Art. XIII. *Observations on Salt Storms, and the Influence of Salt and Saline Air upon Animal and Vegetable Life. Read before the Lyceum of Natural History of New-York, March 7, 1819, by* John B. Beck, M. D.

(Communicated for this Journal.)

Meteorology is a science of so much general concern, that it seems to be incumbent upon every member of society to aid in augmenting the stock of facts, which the labours of ingenious and scientific men have already accumulated on that subject. Under this impression I propose to devote the following paper to some observations on *salt winds* or *storms*, as they have occurred in this country and in Europe—a subject, which although presenting many phenomena of a more than temporary interest, has as yet excited but little attention. Indeed, the opportunities for observation have occurred so rarely as readily to account for its having in a great measure escaped the philosophical acumen of the present age.

It must have been early observed that the atmosphere in the vicinity of the sea frequently becomes impregnated with saline materials; but the first and only account of a *salt storm* that I have met with, is to be found in the Transactions of the Linnæan Society of London. The 8th volume of that work gives an interesting narration of the effects of a storm of this description, which occurred in England, in January, 1803. It was occasioned by an east wind, which blew for some days, and which, in its passage over the ocean, had imbibed large quantities of salt water, which were afterward deposited upon the land. In most cases these depositions proved fatal to the plants and vegetables which received them. So extensive were the effects of this singular [389] storm, that they were felt in the vicinity of London, at a distance of about seventy miles from the ocean, and in all the intermediate country. In most instances, the leaves of the plants, which suffered from it, appeared as if they had been scorched, and in some places even the tops of the branches mortified. A storm of the same kind took place in England, in February, 1804; and the memoir states, that Sir Joseph Banks had noticed another some years before in Lincolnshire.[55]

A storm attended with similar effects occurred in this country in 1815, and vented its fury upon the eastern states. It commenced on the 23d of September, between eight and nine o'clock, A. M. with the wind from the east. In about two hours the wind shifted to southeast, and blew a perfect hurricane. The extended devastation which ensued, is still in the recollection of every person. The tides rose from nine to twelve feet higher than ordinary, and in many of the principal cities and towns along the coast of New England, churches, houses, bridges, wharves, and in some instances valuable citizens, were buried in one common ruin. In less than three hours the gale abated, and before sunset there was a perfect calm. Such were the more striking features of this tremendous gale—but other effects were observed more peculiarly interesting to the philosopher. At New-London, Salem, and other places, both on the coast, and several miles in the interior, the air was found to be loaded with salt; and the leaves of many trees appeared, a few hours after the storm, as if they had been scorched. Besides this effect upon vegetables, there were additional evidences of the saline quality of the wind. At Salem and some other places an incrustation of salt was perceived on the windows, and the fruit in several gardens had a perceptible taste of salt on their surface. At New-London it was remarked that the air in the eddies was extremely hot and suffocating.

Other facts of a similar nature might be collected, but these it is presumed are sufficient to [390] characterize the state of the atmosphere during that storm.

Several interesting inquiries arise from the consideration of the foregoing facts.

1. In what way does the salt exist in the atmosphere in these storms? On this point there are two different opinions. The most prevalent is, that it is merely the spray of the sea driven onward by the force of the wind. This opinion has received the sanction of Sir Joseph Banks,[56] and also of Sir Humphry Davy, if we may judge from an incidental expression in his Agricultural Chemistry.[57] Another opinion[58] is, that muriate of soda is continually rising into the atmosphere from the surface of the ocean, and that the air, in all maritime situations, is thus constantly more or less impregnated with salt. The most striking fact in support of this doctrine, (so opposite to the commonly received views on the subject of the evaporation of sea water) is the actual existence of muriate of soda in the rain and snow which fall in the vicinity of the ocean.[59] The experiments of Vogel and Bouillon Lagrange, on the distillation of sea water, are also in favour of the position, that salt may be carried into the air in the ordinary process of evaporation. On distilling salt water they found a considerable quantity of muriate of soda in the receiver.[60]

Admitting the correctness of these experiments, still it is not easy to conceive, how they will [391] account satisfactorily for the *large* quantities of salt found in the air during the storms under consideration.

Whichever of these solutions may be adopted, it is unquestionably a fact that salt does, in some way or other, exist in the atmosphere in the neighbourhood of the sea.

2. The next object of inquiry is, the influence which this saline air has upon vegetable life. Independently of the facts already stated, there are many others which prove its deleterious agency upon the vegetable creation. Dr. Mitchill informs me, that in some parts of the south side

of Long-Island fruit trees do not thrive well, except at a distance of thirty miles from the sea, and even the sturdy oak does not extend its branches towards the ocean.[61] If I am correctly informed, it was with great difficulty, that the trees on our Battery were made to accommodate themselves to a situation so near the salt water. It is also well known, that when plants are taken to sea, they speedily perish, if exposed but a short time to a wind, which is sufficiently strong to turn over the tops of the waves into *white caps*, as they are called by the sailors.

In order to ascertain positively, whether these effects were to be attributed to the operation of salt, I made a solution of muriate of soda in common rain water; with this I watered for a couple of days the leaves of different plants. In a short time they began to dry up, and in a few days were completely dead.

It appears from Volney, that the Egyptian air is strongly charged with salts. The evidences of it are to be found even at Cairo.[62] It is this property of the air, which this philosophical traveller considers, as one of the causes of the rapid vegetation in that country. He mentions, however, that *exotic* plants will not thrive there. It is found necessary to renew the seeds of them every year. May not this be occasioned by the saline quality of the air? The *native* plants are doubtless [392] accustomed to its action, and do not so sensibly feel its injurious effects. And if the Egyptian air is so very penetrating from this very cause, as to produce ophthalmia, may we not rationally conclude, that its influence must be equally injurious to plants not accustomed to it.

Another illustration of the influence of salt on vegetation is to be found in the *Dead Sea*, or *Lake Asphaltites*. "In Lake Asphaltites," says Volney, "there is neither animal nor vegetable life. No verdure is to be seen on its banks, nor fish to be found within its waters; but it is not true, that its exhalations are pestiferous, so as to destroy birds flying over it. It is not uncommon to see swallows skimming its surface, and dipping for the water necessary to build their nests. The *true* cause which deprives it of vegetables and animals is the extreme saltness of the water, which is vastly stronger than that of the sea. The soil around it, equally impregnated with this salt, produces no plants, and the *air* itself, which becomes loaded with it from evaporation, and which receives also the sulphureous and bituminous vapours, cannot be favourable to vegetation; hence the deadly aspect which reigns around this lake."[63]

3. In what way does the salt operate in producing its deleterious effects on the leaves of vegetables? It is by no means easy to answer this question. It cannot be by shutting up the pores of the leaf, and thus obstructing its perspiration. It is well known that when the surfaces of leaves are covered with oil, they will soon die.[64] But salt water is certainly not sufficiently viscid to act in a similar way.

Nor can it be satisfactorily attributed to the difference of structure between maritime and land plants. There is some difference indeed between many of these, maritime plants being generally covered by a pubescence, of which most land plants are destitute. It is idle however to suppose that the object of this covering is to protect maritime plants from the action of the salt air, as there are many of them which do not possess it. Besides, is it not rational to conclude, from the [393] large quantities of soda which are always found in sea plants, that this saline atmosphere is rather propitious than otherwise to their growth, and that it only proves injurious to plants accustomed to the unadulterated air of the land.

Again, I do not think that it can be explained by supposing, that the salt is absorbed into the plant, and thus acts as a poisonous substance. We know, that in land plants which are cultivated in the neighbourhood of the sea, salt is absorbed through their roots.[65] It must of course circulate with the juices through the whole plant; and yet in these cases the leaves are not destroyed by it.

The most plausible method of explaining it appears to be this: that the salt, by its irritating or corrosive power, destroys the small vessels in the leaf which are necessary for the circulation going on in it during health.

Dr. Darwin has ingeniously shown the analogy between the functions of the leaves of plants, and the lungs of animals. If this be admitted, it will not be difficult to account for the action of salt upon leaves. This substance, when taken into the stomach, proves not merely innocuous, but wholesome; but when accidentally introduced into the lungs, irritation, inflammation, and death are the consequences. So with plants—when admitted into them in combination with their juices, it may be harmless; but when applied to the lungs or leaves, death ensues.

4. I shall devote the remainder of this paper to a few concise observations on the effects of salt, [394] and a saline atmosphere, upon *animal* life.

Upon the more imperfect animals, such as slugs, worms, toads, &c. it is well known that salt proves speedily destructive of life. It is not my intention to attempt an explanation of this singular fact. But it is remarkable that it should not have been turned to better account in the treatment of those worms, which infest the human body. Although used for that purpose by the common people in Ireland as well as in this country, I believe it has not, until very lately, claimed the attention of the profession, as an anthelmintick. A late English journal[66] contains a notice of some cases which satisfactorily prove its efficacy, when administered with this intention. This fact, in addition to numerous others, strikingly illustrates the advantages which the healing art might derive from a careful observation of the phenomena daily developed by the collateral sciences.

In cases of *hæmoptysis* and *hæmatemesis*, common salt has been used with decided success. The public is indebted to Dr. Rush, for the introduction of this remedy into general practice.

Dr. Hosack informs me, that he has found sea air extremely salutary in *remittent fever*, *cholera infantum*, and *dyspepsia*.

Among the deleterious effects caused by a *saline atmosphere*, may be mentioned the *ophthalmia* of Egypt. This disease is so common there, "that out of a hundred persons," says Volney, "I have met while walking the streets of Cairo, twenty have been quite blind, ten wanting an eye, and twenty others have had their eyes red, purulent, or blemished."[67] Throughout the Delta, and at Cairo, this complaint is more prevalent than in any other part of Egypt. In Syria it is also common, although less so than in Egypt, but it is only met with on the *sea-coast*. The reasoning of Volney on this subject, is decisive of the position, that the prevalence of this complaint, in these regions, is owing to their proximity to the ocean. In confirmation, he states [395]
that he has himself experienced the irritating effects of the air of the Delta upon the organ of vision.[68]

In those cases of *scurvy* which occur in long voyages, the saline nature of the atmosphere co-operates very powerfully with salt provisions and bad water, in producing that general vitiation of the system which characterizes this disorder.

Of all diseases, however, those of the lungs appear to be most affected by a saline air. I have known a lady of this city who had been afflicted for many years with *asthma*, to be essentially benefited by a voyage across the Atlantic. Another case has fallen under my observation, of a lady troubled with asthma, being much relieved by removing from the interior to this city. What proves beyond a doubt that her relief is owing to the air she breathes, is, that whenever she takes a jaunt into the country, she is sure to suffer a paroxysm of her old complaint.

Pulmonary consumption certainly prevails more on the sea-coast, than in the interior. In all our sea-port towns, it is this disorder which so frightfully augments the catalogue of our bills of mortality. According to Dr. Rush, "in Salem, in the state of Massachusetts, which is situated near the sea, and exposed, during many months of the year, to a moist east wind, there died in the year 1799, 160 persons; fifty-three of whom died of the consumption."[69] In Philadelphia, which is more remote from the sea, the deaths from consumption are much less numerous than in New-York, or the other cities immediately on the coast. In Great Britain, which is exposed to the sea on all sides, it is calculated that about 55,000 die annually from this disease.

Such are some of the facts on this subject; but the conclusion does not appear to be warranted, [396]
that these pulmonary affections arise from the irritating quality of the air. In Holland, the West Indies, as well as in other countries and islands, exposed to the sea air, consumption is of rare occurrence. In Syria, Volney even states that the air of the coast is particularly favourable to those labouring under this malady. Accordingly they are in the habit of sending such patients from Aleppo to Latakia, or Saide, where they may enjoy the benefit of sea air.[70]

Again, we know that many persons suffering from this affection, have been completely cured by a voyage, after all the resources of medicine had been exhausted upon them in vain.

It is evident then, that a *pure* sea air is not detrimental in cases of consumption. Dr. Rush, with his usual ingenuity, explains the prevalence of this complaint in our sea-ports, by attributing it to the mixture of land and sea air; and in confirmation observes, that "those situations which are in the neighbourhood of bays and rivers, where the fresh and salt waters mix their streams together, are more unfavourable to consumptive patients than the seashore, and therefore should be more carefully avoided by them in exchanging city for country air."[71]

Independently, however, of these causes, I think the frequent and sudden vicissitudes of temperature, which we suffer on the coast, are alone sufficient to account for the prevalence of catarrhal and pneumonic affections, which most commonly are the precursors of consumption.

I trust the foregoing observations have not been considered too *medical* to comport with the objects of this Society. Natural history is only useful in its practical applications; and if it can be shown to throw any light upon an art, which contributes so much to the comfort and happiness of man, we have established one of the strongest considerations, which can recommend it to general patronage and investigation. Physicians ought in an especial manner to set a high value upon the researches of naturalists. The aid they have already given is sufficient to entitle them to [397]
the lasting gratitude of our profession. It was one of the merits of that illustrious physician of our own time and country, Dr. Rush, that he seized with avidity every fact, from whatever quarter it might be drawn, to elucidate his favourite science. If ever medicine shall attain to the elevation of a truly *philosophical science*, it must be accomplished, in part at least, by imitating his example, and by developing the infinite and diversified associations which exist between it and the other sciences.

Art. XIV. *Thoughts on Atmospheric Dust. By* C. S. Rafinesque, *Esq.*

1. "When we find the ruins of ancient cities buried under ground; when the plough uncovers the front of palaces and the summit of old temples, we are astonished: but we seldom reflect why they are hidden in the earth. A sort of imperceptible dust falls at all times from the atmosphere, and it has covered them during ages."

2. These are the words of the worthy and eloquent philosopher Virey, in his article Nature, Vol.

XV. p. 373, of the French Dictionary of Natural History. Even before reading them I had observed the same phenomenon, and I have since studied their effects in various places. I could quote one thousand instances of the extensive and multifarious operations of this meteoric dust: but I mean to give the results merely of those that fall daily under notice, and are yet totally neglected; wishing to draw on them the attention of chemists, philosophers, and geologists.

3. Whenever the sun shines in a dark room, its beams display a crowd of lucid dusty molecules of various shapes, which were before invisible as the air in which they swim, but did exist nevertheless. These form the atmospheric dust; existing every where in the lower strata of our atmosphere. I have observed it on the top of the highest mountains, on Mount Etna, in Sicily, on [398]
the Alps, on the Alleghany and Catskill mountains in America, &c. and on the ocean.

4. It deserves to be considered under many views: which are its invisibility, its shape and size, its formation and origin, its motion, its deposition and accumulation, its composition, its uses, and its properties.

5. This dust is invisible, owing to the tenuity of its particles, but they become visible in the following instances; when the sun shines on them, since they reflect the light, when their size is increased, and when they are accumulated any where.

6. The size of the particles is very unequal, and their shape dissimilar; the greatest portion are exceedingly small, similar to a whitish or grayish spark, without any determinable or perceptible shape; the larger particles are commonly lamellar or flattened, but with an irregular margin, and the largest appear to be lengthened or filiform; the gray colour prevails. Other shapes are now and then perceptible with the microscope.

7. Among the properties of atmospheric dust are those of being soft, as light as atmospheric air, of reflecting the rays received directly from the sun, of possessing a kind of peculiar electricity, which gives it a tendency to accumulate on some bodies more readily than on some others, and of forming an earthy sediment, which does not become effervescent with acids.

8. This dust is either constantly or periodically formed, but chemically in the atmosphere like snow, hail, meteoric stones, honey-dew, earthy rains, &c. by the combination of gaseous and elementary particles dissolved in the air. Its analysis has never been attempted by chemists; but the earthy sediment which is the result of its accumulated deposition, proves that it is a compound of earthy particles in a peculiar state of aggregation, and in which alumine appears to preponderate, rather than calcareous or silicious earths or oxides.

9. Its motion in calm weather, or in a quiet room, is very slow; the particles appear to float in
the air in all directions, some rising, some falling, and many swimming horizontally, or forming a [399]
variety of curved lines; what is most singular, is that no two particles appear to have exactly the same direction; yet after awhile the greatest proportion fall down obliquely, somewhat in the same manner as a light snow in a calm day. When a current of air is created naturally or artificially in the open air or in a room, you perceive at once an increased velocity in their motion; they move with rapidity in all directions; but when a strong current or wind prevails, they are carried with it in a stream, preserving however, as yet, their irregular up and down motion.

10. Its formation is sometimes very rapid, and its accumulation very thick in the lower strata of our atmosphere, but the intensity is variable. Whenever rain or snow falls, this dust is precipitated on the ground by it, whence arises the purity of the air after rain and snow; but a small share is still left, or soon after formed. In common weather it deposits itself on the ground by slow degrees, and the same in closed rooms. It forms then the dust of our floors, the mould of our roofs, and ultimately the surface of our soil, unless driven by winds from one place to another.

11. I have measured its accumulation in a quiet room, and have found it variable from one-fourth of an inch to one inch in the course of one year; but it was then in a pulverulent fleecy state, and might be reduced by compression to one-third of its height, making the average of yearly deposit about one-sixth of an inch. In the open air this quantity must be still more variable, owing to the quantities carried by the winds and waters to the plains, valleys, rivers, the sea, &c. or accumulated in closed places or against walls, houses, &c. I calculate, however, that upon an average, from six to twelve inches are accumulated over the ground in one hundred years, where it mixes with the soil and organic exuviæ, to form the common mould.

12. The uses of this chronic meteor are many and obvious. It serves to create mould over rocks, to increase their decomposition, to add to our cultivable soil, to amalgamate the alluvial and organic deposits, to fertilize sandy and unfruitful tracts in the course of time, to administer to
vegetable life, &c. It does not appear that it has any bad influence on men and animals breathing [400]
it along with air, unless it should be accumulated in a very intense degree.

13. At Segesta, in Sicily, are to be seen the ruins of an ancient temple; the steps, which surround it on all sides below the pillars, are built on a rock, on the top of a hill detached from any other higher ground. Yet now all the steps and the base of the pillars are under the ground, which has accumulated from this dust and the decay of plants (not trees) to which it has afforded food. There are from five to eight feet from the rock to the surface of this new soil, which has chemically combined in a variety of hardness. This soil has arisen there in about 2000 years, notwithstanding the washings of rain. I quote this as a remarkable instance of the increase of soil by aerial deposits, among many which have fallen under my personal examination.

14. It is commonly believed that the dust of our rooms is produced by the fragments of decomposed vestments, beddings, furnitures, &c.; this cause increases it, and produces a different dust, which mixes with the atmospheric dust; but it is very far from producing it.

15. The dust of the open air is ascribed to that raised from roads and fields, by the pulverization of their surface; but this secondary and visible dust is only a consequence of the first. From whence could arise the dust observed by the means of the sunbeams in a dark corner, in winter, when the ground is frozen, or when it is wet and muddy, or at sea, or on the top of rocky mountains?

16. It is therefore a matter of fact, worth taking into consideration by geologists, that the air still deposits a quantity of dust, which must have been much greater in former periods. Just the same as the sea deposits still a quantity of earthy and saline particles dissolved in it, and which were superabundant at the period when the rocky strata were formed on its bottom. Water being more compact, deposits rocks. Air, which is less dense, deposits a pulverulent matter!

Art. XV. *On the Effect of Vapour on Flame. By* J. F. Dana, *Chemical Assistant in Harvard University, and Lecturer on Chemistry and Pharmacy in Dartmouth College*. [401]

Cambridge, Mass. February 5, 1819.

To Professor Silliman.

DEAR SIR,

About a year since I made some experiments on the effect of steam on ignited bodies, with a view to learn the theory of the action of the "American water-burner." These experiments were published in an anonymous paper in the North American Review, and have been published in London, without an acknowledgment of their source.

The effect of them concerning bodies is peculiar, and it probably admits of more extensive application to the arts than in the above named instrument alone.

When a jet of steam, issuing from a small aperture, is thrown on burning charcoal, the brightness is increased, if the coal be held at the distance of four or five inches from the pipe through which the steam passes; but if the coal be held nearer it is extinguished, a circular black spot first appears where the steam is thrown on it. The steam in this case does not appear to be decomposed, and the increased brightness of the coal depends probably on a current of atmospheric air, occasioned by the steam. But when a jet of steam, instead of being thrown on a single coal, is made to pass into a charcoal fire, the vividness of the combustion is increased, and the low attenuated flame of coal is enlarged.

When the wick of a common oil lamp is raised, so as to give off large columns of smoke, and a jet of steam is thrown into it, the brightness of the flame is increased, and no smoke is thrown off.

When spirits of turpentine is made to burn on a wick, the light produced is dull and reddish, and a large quantity of thick smoke is given off; but when a jet of steam is thrown into this flame, [402] its brightness is much increased; and when the experiment is carefully performed, the smoke entirely disappears.

When the vapour of spirits of turpentine is made to issue from a small orifice, and inflamed, it burns, and throws off large quantities of smoke; but when a jet of steam is made to unite with the vapour, the smoke entirely disappears. When vapour of spirits of turpentine and of water are made to issue together from the same orifice, and inflamed, no smoke appears. Hence its disappearing, in the above experiment, cannot be supposed to depend on a current of atmospheric air.

When a jet of steam is thrown into the flame of a spirit of wine lamp, or into flames which evolve no smoke or carbonaceous matter, the same effect is produced as by a current of air.

It appears, from these experiments, that in all flames which evolve smoke, steam produces an increased brightness, and a more perfect combustion.

Now, with a very simple apparatus, steam might be introduced into the flames of street lamps, and that kind of lamp which is used in butchers' shops in London, and in all flames which evolve much smoke. The advantage of such an arrangement would be a more perfect combustion, and a greater quantity of light from the same materials. The flame of the lamps, to which steam is applied, might be made to keep the water boiling which supplies the steam.

I hope the above may not be altogether uninteresting and useless to the readers of your Journal.

Very respectfully, your obedient servant,

J. F. DANA.

Art. XVI. *Analysis of the Harrodsburg Salts, by* Edward D. Smith, M. D. *Professor of Chemistry and Mineralogy in the South-Carolina College*. [403]

More than a year since I received a quantity of a white earthy substance, which was said to be obtained by the evaporation of certain mineral waters at Harrodsburg, Kentucky, and there vended at a considerable price, under the name of Epsom salts. The respectable character who presented this powder to me, requested that I would make an analysis of it; but I had not sufficient leisure until lately, to pay the requisite attention to this subject. The results of my examinations are now submitted to the public eye.

The external qualities of this substance are as follow: small white lumps, hard to the touch, but dry and easily yielding to pressure, somewhat gritty to the teeth, and imparting an earthy and saline taste to the tongue.

1. 120 grains of the powder were put into about a half ounce of alcohol, digested for six hours, then, washed with more alcohol, filtered and carefully dried.

2. On weighing the dry powder, the loss appeared to be but one grain, so that it contains very little of any substance which is soluble in alcohol.

3. 115 grains (four grains having been lost in the transfer from the filter) were collected and put into rather more than eight times their weight of cold distilled water, and digested for two hours.

4. This watery solution was then filtered, and on weighing, the residue appeared to be 48 grains, so that 67 grains must have been dissolved.

5. 10 grains of the insoluble residue (4) were put into a flask, with 10 ounces of distilled water, and boiled for 1 hour.

6. A small portion of this solution, on being tested with nitrate of barytes, gave a copious white precipitate, with oxalic acid, a white cloud; with ammonia, a slight white cloud; with muriatic acid, a slight bluish tinge. From these tests it was inferred that sulphate of lime was present, with [404] perhaps a slight trace of muriate of lime.

7. The remainder of this solution was filtered, and on weighing the dried residuum, the loss appeared to be 2 grains, so that sulphate of lime probably constitutes nearly ⅕ of the insoluble residence (48 grains. 4.)

8. The watery solution, (4) which was supposed to contain 67 grains, was evaporated, and left a residue that weighed but 34 grains, so that 33 grains must have disappeared in the process.

9. Some of this residue dissolved in distilled water, was tested with carbonate of soda, forming an immediate white cloud; with nitrate of barytes, the same; with ammonia, the same; but with oxalate of ammonia, it did not form any cloud until it had stood some time, and then it was slight. From these tests it was inferred that sulphate of magnesia was present.

10. A portion of the dried residuum (7) was treated with diluted muriatic acid, which dissolved nearly the whole of it, with considerable effervescence. The new compound, on examination, proved to be muriate of lime; so that it may be concluded the residuum (7) was principally carbonate of lime.

On considering the results of the preceding experiments, it will appear that more than one half of the substances submitted to analysis, was easily soluble in water, and from the chemical tests used, that it was composed principally of sulphate of magnesia, (Epsom salt) with perhaps a small portion of muriate of lime or magnesia, that of the remainder, about ⅕ was sulphate of lime, and difficultly soluble in water; and that the rest was perfectly insoluble in water, and consisted principally of carbonate of lime.

There can be no doubt then, that the Harrodsburg salt, in its present state, is very improperly prepared, containing in its composition a large proportion of matter, that is not only inert, but which may produce considerable inconvenience and injury in the stomach and bowels, from its ponderous nature and tendency to form mechanical obstructions. Perhaps the occurrence of such injury may not be frequent, from the circumstance of a large portion of the salt being so insoluble; but admitting this to be the fact, there is a manifest impropriety in offering to the [405] public, as medicine, an article which cannot be used as such. Probably the proprietors of this manufactory are not aware of the real nature of the case, and of the facility with which, by a little additional trouble, they could separate the useful and valuable material, from that which is at least useless, and which might also be pernicious.

South-Carolina College, March, 1819.

Art. XVII. *Additional Notice of the Tungsten and Tellurium, mentioned in our last Number.*

Part I. *Description of the Ore.*

Colour, dark brown, almost black; brittle, powder a lighter shade of brown than the mineral; hard, scratches glass, scintillates with steel, with a red spark; a degree of polish produced, where the steel strikes, and when the steel is impressed upon it.

Structure compact, in some places slightly porous; lustre, generally dull, sometimes glimmering, and almost resinous.

Crystals octahedral. Specific gravity of three massive pieces, 5.7, 6. and 6.44 mean, 6.05 nearly; probably that of the crystals would be higher.

Infusible by the blow-pipe even with borax, and does not by strong ignition impart any colour to it or to potash; not magnetic, even in fine powder, nor after being heated red hot on charcoal, and in contact with burning grease.

Many specimens decrepitate violently under the blow-pipe. When heated on coals in pieces of considerable size, they often explode with a smart report, and are thrown in fragments sometimes several yards from the fire.

Gangue quartz; accompanying minerals in the same vein, native bismuth, native silver, galena, iron and copper pyrites, much magnetic pyrites, blende, &c.

Geological relations. The country is primitive, and the immediate rock which forms the walls of [406] the vein is said to be gneiss; (we have not seen it.)

Locality, town of Huntington, parish of New Stratford, county of Fairfield, 20 miles west from New-Haven, Connecticut.

Remark. Native bismuth in small quantities, has been for several years obtained from this mine, but the shaft has been sunk only about ten feet.

Part II. *A variety of the Ore.*

General characters as above, but on some parts, there is seen a whitish, or yellowish, or sometimes darkish metallic substance; it is in thin plates, like the leaf metals, and sometimes reticulated, and graphic in its disposition; it is soft and easily cut with the knife. In the specimens examined, it was so much blended with the other ore, and so trifling in quantity, that it was not possible to separate it mechanically, so as to examine it separately.

Part III.—A. *Chemical Trials.*

1. Muriatic acid, hot or cold, produces no effect; hot nitro-muriatic dissolves the ore with energy, red fumes are evolved, and generally a red solution obtained, from which ammonia precipitates red oxyd of iron abundantly.

2. A heavy lemon-yellow powder remains, insoluble of course in acids, but easily and completely soluble in warm ammonia.

3. A dark powder, in diminished quantity, again appears, more acid dissolves it in part, and again reveals the yellow powder, which ammonia again dissolves, and so on, till nothing remains but some portion of the gangue.

4. The ammoniacal solution, which contains the oxyd of tungsten, is decomposed by acids, and by heat, and instantly deposits a white heavy powder, becoming yellowish by standing, and full yellow by heat.

5. This powder is infusible by the blow-pipe, but ignited with borax in a platinum crucible, it [407] became of a superb blue, like smalt, or between that and Prussian blue.

6. The quantity obtained was too small to make it convenient to attempt its reduction to the metallic state; no doubt remained, however, that it was oxyd of tungsten, or as it is sometimes called, tungstic acid.

7. There were traces of manganese, and all the facts perhaps justify the conclusion, that the ore is very similar to the ferruginous tungsten or wolfram.

8. The calcareous tungsten occurs in octahedral crystals, but we have not before heard of this form in the ferruginous species, which generally affects the prismatic forms.

B. remark.

We had been for some time inclined to believe, that the above ore was ferruginous tungsten, but although fortified by the opinion of Col. Gibbs, we were withheld from announcing it, because the form of the crystals, the specific gravity, the colour, and perhaps some other characters, were not perfectly accordant with European descriptions, and with the specimens in our possession, which are from Saxony and Cornwall.

During the necessary chemical trials (which have, we trust, established the correctness of the above opinion,) we very unexpectedly discovered in some of the ores of tungsten, proofs of the existence of tellurium. The conclusion was induced by the phenomena, for nothing was farther from our expectations.

Two fragments were pulverized *by an assistant*, and we therefore cannot say whether they had any external characters different from those of the other pieces; they came, however, from the same part of the vein, and their powder resembled that of the other pieces.

1. Digested in nitro-muriatic acid, a straw-yellow solution, slightly inclining to green, was obtained, and a black powder was left behind.

2. More acid digested on this powder, gave a deep red solution of iron, and left the yellow oxyd of tungsten, which being dissolved in ammonia, the black powder again appeared, and so on, as [408] under 3. Part III.

3. The solution 1, diluted largely with water, deposited an abundant white precipitate, which was very heavy and rapidly subsided.

4. Alcohol and ammonia, respectively produced the same effect, only more decidedly.

5. This precipitate, evidently an oxyd of a metal, being collected on a filter and dried, exhibited

the following properties.

6. Heated by the blow-pipe on charcoal, it was instantly volatilized in part, and in part decomposed, with an almost explosive effervescence; numerous ignited globules of metal appeared on the charcoal, and burned with an abundant flame of a delicate blue colour, edged occasionally with green.

7. In many trials, these results always occurred, and sometimes a peculiar odour was perceived, at first thought to be owing to arsenic, but it was incomparably feebler, and somewhat resembled that of radishes.[72]

8. Zinc, iron, and tin, plunged into separate portions of the nitro-muriatic solution, precipitated abundantly a black flocculent substance.

9. On charcoal before the blow-pipe, this substance was very combustible, with a blue flame, and was completely dissipated in the form of white oxyd, with the above smell.

10. Some of it was obtained on the charcoal in metallic globules; it was a brittle metal, white, with a tinge of red, and foliated, but not so distinctly as bismuth and antimony.

11. The filters on which the white oxyd had been deposited, burned almost with explosion, nearly as rapidly as if they had been soaked with nitrate of potash, or of ammonia, and the characteristic blue flame appeared while the burning lasted.

12. Other experiments were made upon the metal, (not the oxyd.) It gave to strong sulphuric acid, (simply by standing in it in the cold) an amethystine colour, which disappeared as the acid grew weaker, by attracting water from the air. [409]

13. With nitric acid it formed a colourless solution, not decomposed by water.

14. It did not dissolve in muriatic acid, till a few drops of nitric acid were added.

15. The white oxyd heated with charcoal in a small coated recurved glass tube, afforded brilliant metallic globules, which rose by distillation, collected in the bend of the tube, and resembled drops of quicksilver, except that they were solid.

C. REMARK.

The above facts having induced the conclusion that the metal, thus unexpectedly discovered in the ores of tungsten, was tellurium,[73] we were led to search for external characters by which to judge what specimens contained it. The ores from Transylvania, (the only telluric ores with which we are acquainted,) bearing no analogy in appearance or composition to those before us, we were led to inquire whether the tellurium in these latter ores was *in combination* with tungsten, or merely *in mixture*. The external characters detailed in part II, tend perhaps to fortify the latter opinion. If we mistake not, we there found a proper ore of tellurium mixed with a proper ore of tungsten, but we have also by chemical means, found tellurium where similar external characters were not apparent. Before the appearance of our next Number, we hope to obtain purer and better specimens. In the mean time we add the following facts.

1. A crystal, and a massive piece of the kind described under part I, and specimens of two varieties of those described under part II, were digested in nitro-muriatic acid.

2. Both oxyd of tungsten, and oxyd of tellurium were obtained from all of them. [410]

3. Many specimens have been examined which have afforded tungsten only, and no tellurium.

At a convenient time, it is hoped that a more complete examination of this subject may be presented to the public.

In the mean time, we may submit to mineralogists and chemists, whether if this is not a new mineral, it is not at least a new association of two minerals before known. It has not been forgotten that gold and silver are frequently combined with tellurium: neither of them has, however, been discovered, (although sought after by proper tests) during the above trials.

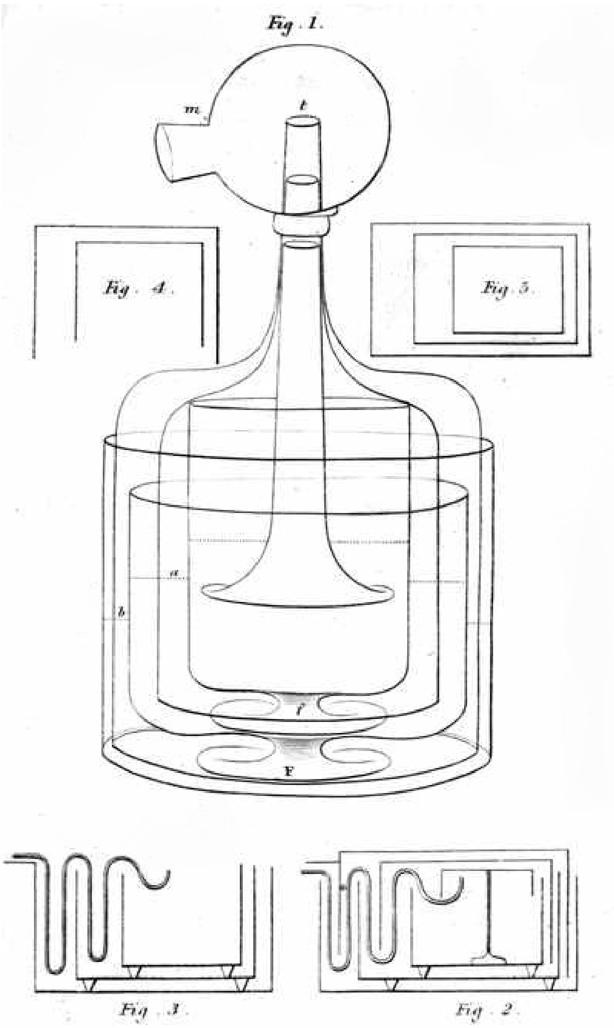
Yale College, March, 1819.

ART. XVIII. *A Substitute for Woulfe's or Nooth's Apparatus, by* ROBERT HARE, M. D. *Professor of Chemistry in the Medical Department of the University of Pennsylvania, and Member of various Learned and Scientific Societies*. With a Plate.

Few subjects have more occupied the attention of chemists, than the means of impregnating fluids with gaseous substances. The contrivances of Woulfe and Nooth, especially the former, have been almost universally used; and have gained for the inventors merited celebrity. Various improvements in Woulfe's bottles have been devised. Still I believe an apparatus replete with similar advantages, but less unwieldy, less liable to fracture; and having fewer junctures to make at each operation, has been a great desideratum with every practical chemist. It has, however, ceased to be so with me, since I contrived the apparatus which I am about to describe.

Fig. 1. represents 3 jars placed concentrically within each other, and so proportioned and situated, as to admit 2 open-necked concentric bell glasses alternately between them. The neck of the exterior bell glass is introduced into the tubulure of the receiver above, and receives the [411]

neck of the interior bell glass. Into this is inserted a trumpet-shaped tube. The two interior jars are furnished with feet F, *f*. In order to put this apparatus into operation, remove (without taking them apart) the bell glasses, receiver, and tube from the jars. Pour into the latter the fluid, to be impregnated, till it reaches the height marked by the dots. The funnel mouth, *m*, of the receiver being provided with a suitable cork soaked in wax, fasten into it firmly the beak of the retort, containing the generating materials. The bell glasses are then to be replaced in the jars, and arranged as in the figure. It must be self-evident that the gas proceeding from the retort, (if the juncture at *m* be air tight) must press on the fluid in the innermost jar, through the trumpet-shaped tube. If not imbibed with adequate speed, it must soon press on the fluid at *a*, causing it to subside to the narrow part of the foot *f*, and thus to expose a much larger surface. If the absorption be still inadequate, a further subsidence must ensue, and the gas escaping round the brim of the interior bell glass will act on the fluid at *b*, and enlarge its surface by depressing it to the narrow part of the foot F. Should the increased pressure and more extended contact thus obtained, be still incompetent to effect a complete absorption, the excess of the gas may escape round the brim of the external bell glass into the atmosphere.



Drawn & Engraved by Kneass, Young & Co.

But so effectual is this process in promoting impregnation, that I have obtained strong muriatic acid in the central jar, without producing any sensible acidity in the outside one. Absorption into the retort or receiver, is prevented by not allowing as much fluid to be above the mouth of the trumpet-shaped tube, as would be competent to fill the cavity between it, and the termination of the open neck of the exterior bell glass at *t*. As this neck rises about 2 or 3 inches into the receiver, it prevents any foul matter which may condense or boil over, from getting into the jars. If practicable, it would be better that the bell glasses, and tube, and receiver, should be united together while hot, at the glass-house. If all could not be joined in this way, it would still be advantageous to unite thus the receiver, and the exterior bell glass. The interior bell and tube [412]
might then be fastened together, by grinding or luting. As yet I have only used lutings of waxed cloth, or cork. It may be proper to point out, that 3 or more concentric bell glasses, and 4 or more jars, might be used. The union of the bells, receiver, and tube once effected, it is hardly more troublesome to use 3 than 2. When the fluid in the central jar is saturated, this may be emptied and replenished from the middle jar, the latter from the external one. Then supplying the external jar anew, the process may be continued.

The other figures are to explain an apparatus on the same principle, constructed of hollow, oblong paralellopipeds, differing in length more than in breadth; so as to allow a serpentine tube to wind into the interior, and deliver gas under a vessel shaped like a T.

Fig. 2. represents a vertical section of the whole as when situated for use.[74]

Fig. 3. a vertical section of the lower vessels only.

Fig. 4. a vertical section of the covers alone.

Fig. 5. a horizontal section, or ground plan of the lower vessels. The upper vessels are so proportioned as to divide the distances between the lower ones equally.

It may be well to mention, that this apparatus, from the facility with which it may be cleaned and inspected internally, admits of being made of porcelain or stone ware.[75] I have had a cylindrical one constructed of the latter material, in which the covers are in one piece, with a tube in the centre for introducing gas. The apparatus may be made more efficacious, by drilling a series of small holes round the brims of the bell glasses or covers, so as to cause the gas, instead of passing round the brims in large bubbles, to divide itself into very small ones. By this means it will be more thoroughly intermingled with fluid.

Art. XIX. *A New Theory of Galvanism, supported by some Experiments and Observations made by means of the Calorimotor, a new Galvanic Instrument. Read before the Academy of Natural Sciences, Philadelphia,*[76] *by* Robert Hare, M. D. *Professor of Chemistry in the Medical Department of the University of Pennsylvania, and Member of several Learned Societies*. [413]

(With an Engraving.)

I have for some time been of opinion that the principle extricated by the Voltaic pile is a compound of caloric and electricity, both being original and collateral products of Galvanic action.

The grounds of this conviction and some recent experiments confirming it, are stated in the following paper.

It is well known that heat is liberated by the Voltaic apparatus, in a manner and degree which has not been imitated by means of mechanical electricity; and that the latter, while it strikes at a greater distance, and pervades conductors with much greater speed, can with difficulty be made to effect the slightest decompositions. Wollaston, it is true, decomposed water by means of it; but the experiment was performed of necessity on a scale too minute to permit of his ascertaining, whether there were any divellent polar attractions exercised towards the atoms, as in the case of the pile. The result was probably caused by mechanical concussion, or that process by which the particles of matter are dispersed when a battery is discharged through them. The opinion of Dr. Thomson, that the fluid of the pile is in quantity greater, in intensity less, than that evolved by the machine, is very inconsistent with the experiments of the chemist above mentioned, who, before he could effect the separation of the elements of water by mechanical electricity, was obliged to confine its emission to a point imperceptible to the naked eye. If already so highly intense, [414] wherefore the necessity of a further concentration? Besides, were the distinction made by Dr. Thomson correct, the more concentrated fluid generated by a galvanic apparatus of a great many small pairs, ought most to resemble that of the ordinary electricity; but the opposite is the case. The ignition produced by a few large Galvanic plates, where the intensity is of course low, is a result most analogous to the chemical effects of a common electrical battery. According to my view, caloric and electricity may be distinguished by the following characteristics. The former permeates all matter more or less, though with very different degrees of facility. It radiates through air, with immeasurable celerity, and distributing itself in the interior of bodies, communicates a reciprocally repellent power to atoms, but not to masses. Electricity does not radiate in or through any matter; and while it pervades some bodies, as metals, with almost infinite velocity; by others, it is so far from being conducted, that it can only pass through them by a fracture or perforation. Distributing itself over surfaces only, it causes repulsion between masses, but not between the particles of the same mass. The disposition of the last-mentioned principle to get off by neighbouring conductors, and of the other to combine with the adjoining matter, or to escape by radiation, would prevent them from being collected at the positive pole, if not in combination with each other. Were it not for a modification of their properties, consequent to some such union, they could not, in piles of thousands of pairs, be carried forward through the open air and moisture; the one so well calculated to conduct away electricity, the other so favourable to the radiation of caloric.

Pure electricity does not expand the slips of gold-leaf, between which it causes repulsion, nor does caloric cause any repulsion in the ignited masses which it expands. But as the compound fluid extricated by Galvanic action, which I shall call electro-caloric, distributes itself through the interior of bodies, and is evidently productive of corpuscular repulsion, it is in this respect more allied to caloric than to electricity.

It is true, that when common electricity causes the deflagration of metals, as by the discharge of a Leyden jar, it must be supposed to insinuate itself within them, and cause a reaction between their particles. But in this case, agreeably to my hypothesis, the electric fluid combines with the latent caloric previously existing there, and, adding to its repulsive agency, causes it to overpower cohesion.[77] [415]

Sir Humphry Davy was so much at a loss to account for the continued ignition of wire at the poles of a Voltaic apparatus, that he considers it an objection to the materiality of heat; since the wire could not be imagined to contain sufficient caloric to keep up the emission of this principle for an unlimited time. But if we conceive an accumulation of heat to accompany that of electricity throughout the series, and to be propagated from one end to the other, the explanation of the phenomenon in question is attended by no difficulty.

The effect of the Galvanic fluid on charcoal is very consistent with my views, since, next to metals, it is one of the best conductors of electricity, and the worst of heat, and would therefore arrest the last, and allow the other to pass on. Though peculiarly liable to intense ignition, when exposed between the poles of the Voltaic apparatus, it seems to me it does not display this characteristic with common electricity. According to Sir Humphry Davy, when in connexion with the positive pole, and communicating by a platina wire with the negative pole, the latter is less heated than when, with respect to the poles, the situation of the wire and charcoal is reversed. The rationale is obvious: charcoal, being a bad conductor, and a good radiator, prevents the greater part of the heat from reaching the platina, when placed between it and the source whence the heat flows.

I had observed that as the number of pairs in Volta's pile had been extended, and their size and the energy of the interposed agents lessened, the ratio of the electrical effects to those of heat [416] had increased; till in De Luc's column they had become completely predominant; and, on the other hand, when the pairs were made larger and fewer (as in Children's apparatus) the calorific influence had gained the ascendancy. I was led to go farther in this way, and to examine whether one pair of plates of enormous size, or what might be equivalent thereto, would not exhibit heat more purely, and demonstrate it, equally with the electric fluid, a primary product of Galvanic combinations. The elementary battery of Wollaston, though productive of an evanescent ignition, was too minute to allow him to make the observations which I had in view.

Twenty copper and twenty zinc plates, about nineteen inches square, were supported vertically in a frame, the different metals alternating at one half inch distance from each other. All the plates of the same kind of metal were soldered to a common slip, so that each set of homogeneous plates formed one continuous metallic superficies. When the copper and zinc surfaces, thus formed, are united by an intervening wire, and the whole immerged in an acid, or aceto-saline solution, in a vessel devoid of partitions, the wire becomes intensely ignited; and when hydrogen is liberated it usually takes fire, producing a very beautiful undulating, or coruscating flame.

I am confident, that if Volta and the other investigators of Galvanism, instead of multiplying the pairs of Galvanic plates, had sought to increase the effect by enlarging one pair as I have done, (for I consider the copper and zinc surfaces as reduced to two by the connexion) the apparatus would have been considered as presenting a new mode of evolving heat, as a primary effect independently of electrical influence. There is no other indication of electricity when wires from the two surfaces touch the tongue, than a slight taste, such as is excited by small pieces of zinc and silver laid on it and under it, and brought into contact with each other.

It was with a view of examining the effects of the proximity and alternation in the heterogeneous plates that I had them cut into separate squares. By having them thus divided, I [417] have been enabled to ascertain that when all of one kind of metal are ranged on one side of the frame, and all of the other kind on the other side of it, the effect is no greater than might be expected from one pair of plates.

Volta, considering the changes consequent to his contrivance as the effect of a movement in the electric fluid, called the process electro-motion, and the plates producing it electro-motors. But the phenomena show that the plates, as I have arranged them, are calori-motors, or heat movers, and the effect calori-motion. That this is a new view of the subject, may be inferred from the following passage in Davy's Elements. That great chemist observes, "When very small conducting surfaces are used for conveying very large quantities of electricity, they become ignited; and of the different conductors that have been compared, charcoal is most easily heated by electrical discharges,[78] next iron, platina, gold, then copper, and lastly, zinc. The phenomena of electrical ignition, whether taking place in gaseous, fluid, or solid bodies, always seem to be the result of a violent exertion of the electrical attractive and repellent powers, which may be connected with motions of the particles of the substances affected. That no subtile fluid, such as the matter of heat has been imagined to be, can be discharged from these substances, in consequence of the effect of the electricity, seems probable, from the circumstance, that a wire of platina may be preserved in a state of intense ignition in vacuo, by means of the Voltaic apparatus, for an unlimited time; and such a wire cannot be supposed to contain an inexhaustible quantity of subtile matter."

But I demand where are the repellent and attractive powers to which the ignition produced by the Calorimotor can be attributed? Besides, I would beg leave respectfully to inquire of this illustrious author, whence the necessity of considering the heat evolved under the circumstances alluded to as the effect of the electrical fluid; or why we may not as well suppose the latter to be excited by the heat? It is evident, as he observes, that a wire cannot be supposed to contain an [418] inexhaustible supply of matter however subtile; but wherefore may not one kind of subtile matter be supplied to it from the apparatus as well as another; especially, when to suppose such a supply is quite as inconsistent with the characteristics of pure electricity, as with those of pure caloric?

It is evident from Mr. Children's paper in the Annals of Philosophy, on the subject of his large apparatus, that the ignition produced by it was ascribed to electrical excitement.

For the purpose of ascertaining the necessity of the alternation and proximity of the copper and zinc plates, it has been mentioned that distinct square sheets were employed. The experiments have since been repeated and found to succeed by Dr. Patterson and Mr. Lukens, by means of two continuous sheets, one of zinc, the other of copper, wound into two concentric coils or spirals. This, though the circumstance was not known to them, was the form I had myself proposed to adopt, and had suggested as convenient for a Galvanic apparatus to several friends at the beginning of the winter;[79] though the consideration above stated induced me to prefer for a first experiment a more manageable arrangement.

Since writing the above, I find that when, in the apparatus of twenty copper and twenty zinc plates, ten copper plates on one side are connected with ten zinc on the other, and a communication made between the remaining twenty by a piece of iron wire, about the eighth of an inch in diameter, the wire enters into a vivid state of combustion on the immersion of the plates. Platina wire equal to No. 18 (the largest I had at hand) is rapidly fused if substituted for the iron.

This arrangement is equivalent to a battery of two large Galvanic pairs; excepting that there is no insulation, all the plates being plunged in one vessel. I have usually separated the pairs by a board, extending across the frame merely.

Indeed, when the forty plates were successively associated in pairs, of copper and zinc, though suspended in a fluid held in a common recipient without partitions; there was considerable [419]
intensity of Galvanic action. This shows that, independently of any power of conducting electricity, there is some movement in the solvent fluid which tends to carry forward the Galvanic principle from the copper to the zinc end of the series. I infer that electro-caloric is communicated in this case by circulation, and that in non-elastic fluids the same difficulty exists as to its retrocession from the positive to the negative end of the series, as is found in the downward passage of caloric through them.

It ought to be mentioned, that the connecting wire should be placed between the heterogeneous surfaces before their immersion, as the most intense ignition takes place immediately afterward. If the connexion be made after the plates are immersed, the effect is much less powerful; and sometimes after two or three immersions the apparatus loses its power, though the action of the solvent should become in the interim much more violent. Without any change in the latter, after the plates have been for some time suspended in the air, they regain their efficacy. I had observed in a Galvanic pile of three hundred pairs of two inches square, a like consequence resulting from a simultaneous immersion of the whole.[80] The bars holding the plates were balanced by weights, as window-sashes are, so that all the plates could be very quickly dipped. A platina wire, No. 18, was fused into a globule, while the evolution of potassium was demonstrated by a rose-coloured flame arising from some potash which had been placed between the poles. The heat however diminished in a few seconds, though the greater extrication of hydrogen from the plates indicated a more intense chemical action.

Agreeably to an observation of Dr. Patterson, electrical excitement may be detected in the apparatus by the condensing electroscope; but this is no more than what Volta observed to be the consequence of the contact of heterogeneous metals.

The thinnest piece of charcoal intercepts the calorific agent, whatever it may be. In order to ascertain this, the inside of a hollow brass cylinder, having the internal diameter two inches, and [420]
the outside of another smaller cylinder of the same substance, were made conical and correspondent, so that the greater would contain the less, and leave an interstice of about one-sixteenth of an inch between them. This interstice was filled with wood, by plugging the larger cylinder with this material, and excavating the plug till it would permit the smaller brass cylinder to be driven in. The excavation and the fitting of the cylinders was performed accurately by means of a turning lathe. The wood in the interstice was then charred by exposing the whole covered by sand in a crucible to a red heat. The charcoal, notwithstanding the shrinkage consequent to the fire, was brought into complete contact with the inclosing metallic surfaces by pressing the interior cylinder further into the exterior one.

Thus prepared, the interior cylinder being made to touch one of the Galvanic surfaces, a wire brought from the other Galvanic surface into contact with the outside cylinder, was not affected in the least, though the slightest touch of the interior one caused ignition. The contact of the charcoal with the containing metals probably took place throughout a superficies of four square inches, and the wire was not much more than the hundredth part of an inch thick, so that unless it were to conduct electricity about forty thousand times better than the charcoal, it ought to have been heated; if the calorific influence of this apparatus result from electrical excitement.

I am led finally to suppose, that the contact of dissimilar metals, when subjected to the action of solvents, causes a movement in caloric as well as in the electric fluid, and that the phenomena of Galvanism, the unlimited evolution of heat by friction, the extrication of gaseous matter without the production of cold, might all be explained by supposing a combination between the fluids of heat and electricity. We find scarcely any two kinds of ponderable matter which do not exercise more or less affinity towards each other. Moreover, imponderable particles are supposed highly attractive of ponderable ones. Why then should we not infer the existence of similar affinities between imponderable particles reciprocally? That a peculiar combination [421]
between heat and light exists in the solar beams, is evident from their not imparting warmth to a lens through which they may pass, as do those of our culinary fires.

Under this view of the case, the action of the poles in Galvanic decomposition is one of complex affinity. The particles of compounds are attracted to the different wires agreeably to their susceptibilities to the positive and negative attraction, and the caloric leaving the electric fluid with which it had been combined, unites with them at the moment that their electric state is neutralized.

As an exciting fluid, I have usually employed a solution of one part sulphuric acid, and two parts muriate of soda with seventy of water; but, to my surprise, I have produced nearly a white heat by an alkaline solution barely sensible to the taste.

For the display of the heat effects, the addition of manganese, red lead, or the nitrates, is advantageous.

The rationale is obvious. The oxygen of these substances prevents the liberation of the gaseous hydrogen, which would carry off the caloric. Adding to diluted muriatic acid, while acting on zinc, enough red lead to prevent effervescence, the temperature rose from 70 to 110 Fahrenheit.

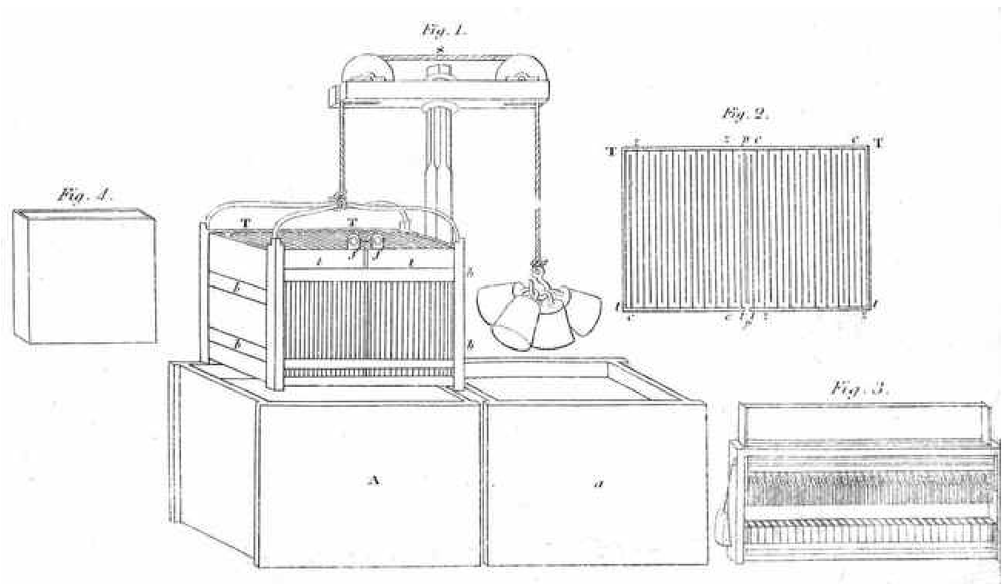
The power of the calorimotor is much increased by having the communication between the different sheets formed by very large strips or masses of metal. Observing this, I rendered the sheets of copper shorter by half an inch, for a distance of four inches of their edges, where the communication was to be made between the zinc sheets; and, vice versa, the zinc was made in the same way shorter than the copper sheets where these were to communicate with each other. The edges of the shortened sheets being defended by strips of wood, tin was cast on the intermediate protruding edges of the longer ones, so as to embrace a portion of each equal to about one quarter of an inch by four inches. On one side, the tin was made to run completely across, connecting at the same time ten copper and ten zinc sheets. On the other side there was an interstice of above a quarter of an inch left between the stratum of tin embracing the copper, and that embracing the zinc plates. On each of the approaching terminations of the connecting [422] tin strata was soldered a kind of forceps, formed of a bent piece of sheet brass, furnished with a screw for pressing the jaws together. The distance between the different forceps was about two inches. The advantage of a very close contact was made very evident by the action of the screws; the relaxation or increase of pressure on the connecting wire by turning them being productive of a correspondent change in the intensity of ignition.

It now remains to state, that by means of iron ignited in this apparatus, a fixed alkali may be decomposed extemporaneously.[81] If a connecting iron wire, while in combustion, be touched by the hydrate of potash, the evolution of potassium is demonstrated by a rose-coloured flame. The alkali may be applied to the wire in small pieces in a flat hook of sheet iron. But the best mode of application is by means of a tray made by doubling a slip of sheet iron at the ends, and leaving a receptacle in the centre, in which the potash may be placed covered with filings. This tray being substituted for the connecting wire, as soon as the immersion of the apparatus causes the metal to burn, the rose-coloured flame appears, and if the residuum left in the sheet iron be afterward thrown into water, an effervescence sometimes ensues.

I have ascertained that an iron heated to combustion, by a blacksmith's forge fire, will cause the decomposition of the hydrate of potash.

The dimensions of the Calorimotor may be much reduced without proportionably diminishing the effect. I have one of sixty plates within a cubic foot, which burns off No. 16, iron wire. A good workman could get 120 plates of a foot square within a hollow cube of a size no larger. But the inflammation of the hydrogen which gives so much splendour to the experiment, can only be exhibited advantageously on a large scale.

[423]



Drawn & Engraved by Kneass, Young & Co.

EXPLANATION OF THE PLATE.

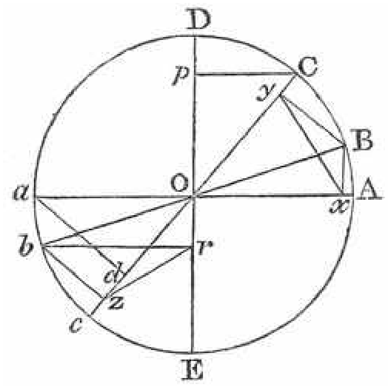
A *a*, Fig. 1st, two cubical vessels, 20 inches square, inside. *b b b b* a frame of wood containing 20 sheets of copper, and 20 sheets of zinc, alternating with each other, and about half an inch apart. T T *t t* masses of tin cast over the protruding edges of the sheets which are to communicate with each other. Fig. 2, represents the mode in which the junction between the various sheets and tin masses is effected. Between the letters *z z*, the zinc only is in contact with the tin masses. Between *c c* the copper alone touches. It may be observed, that, at the back of the frame, ten sheets of copper between *c c*, and ten sheets of zinc between *z z*, are made to communicate, by a common mass of tin extending the whole length of the frame, between T T: but in front, as in fig. 1, there is an interstice between the mass of tin connecting the ten copper sheets, and that connecting the ten zinc sheets. The screw forceps, appertaining to each of the tin masses, may be seen on either side of the interstice: and likewise a wire for ignition held between them. The application of the rope, pulley, and weights, is obvious. The swivel at S permits the frame to be swung round and lowered into water in the vessel *a*, to wash off the acid, which, after immersion in the other vessel, might continue to act on the sheets, encrusting them with oxide. Between *p p* there is a wooden partition which is not necessary, though it may be beneficial.

Fig. 3, represents an apparatus alluded to, page 419. It consists of a couronne des tasses, reduced to a form no less compact than that of the trough. Hollow parallelopipeds of glass are substituted for tumblers or cells. The plates are suspended to bars counterpoised like window-sashes.

The advantages are as follows. The material is one of the best non-conductors, is easily cleansed, and is the most impervious to solvents. The fracture of one of the cups is easily remedied by a supernumerary. They may be procured (as in the United States) where porcelain cannot be had. The shock from 300 pairs is such as few will take a second time. Some of the effects have already been stated.[82]

At Fig. 4, one of the hollow glass parallelopipeds on an enlarged scale is represented.

ART. XX. *An improved Method of obtaining the Formulæ for the Sines and Cosines of the Sum and Difference of two Arcs, by* PROFESSOR STRONG, *of Hamilton College.*



In the circle ABCD let AB and BC denote any two arcs contiguous to each other. Draw their limiting diameters A*a*, C*c*; their sines B*x*, B*y*; and join *x*, *y*. Then will *xy* = sine of (AB + BC): for if upon OB as a diameter we describe a circle, it will manifestly pass through the points *x* and *y*, (since the angles O*x*B, O*y*B are right, see Euc. 31. 3.) therefore O*x*B*y* is a quadrilateral inscribed in a circle described on OB as a diameter, and the angle *y*O*x* at the circumference stands upon an arc whose chord is *xy*. Again, if from *a* we draw *ad* perpendicular to C*c*, it will be the sine of the arc *ac* (= AB + BC). If now we describe a circle on *a*O as diameter, it will pass through *d*, (see Euc. 31. 3.) therefore *ad* is the chord of an arc on which the angle *a*O*c* stands in the circle described on *a*O. But in equal circles the chords of arcs on which equal angles at the centres or circumferences stand are equal; (see Euc. 26. and 29. 3.) hence *xy* = *ad* = sin(AB + BC). Now sine O*x*B*y* is a quadrilateral inscribed in the circle described on OB as diameter, we shall have (Euc. D. 6.) OB · *xy* = B*x* · O*y* + B*y* · O*x* = sinAB · cosCB + sinCB · cosAB. If OB be denoted by *r*, we shall have *xy*, or sin(AB + BC) =

$$\frac{\text{sinAB} \cdot \text{cosCB} + \text{sinCB} \cdot \text{cosAB}}{r}.$$

If AB = A, BC = B, and the radius $r = 1$, sin(A + B) = sinA · CosB + sinB · cosA; which is the known formula for the sine of the sum of two arcs, to the radius 1. [425]

Again, if through O we draw the diameter DE perpendicular to A*a*, then will DC be the complement of (AB + BC). Draw C*p*, the sine of DC = cos(AB + BC). Through B draw the diameter B*b*; from *b*, draw the sines *bz*, *br*, of the arcs *bc*, *b*E respectively, and join *z*, *r*. Then by describing two circles, one on *b*O as diameter, the other on OC, it may be proved as before that the circle described on *b*O passes through the points *z* and *r*, and that the circle described on CO passes through *p*: and hence, by the same reasoning as before, *zr* = C*p* = cos(AB + BC). Now O*bzr* being a quadrilateral inscribed in the circle described on *b*O, we have (by the prop. before cited) *b*O · *zr* + O*r* · *bz* = *br* · O*z*; and hence *b*O · *zr* = *br* · O*z* – O*r* · *bz*. But *br* = sine arc *b*E = sine arc BD; and since BD is the complement of AB, *br* = cosAB. In like manner O*z* = cosBC, O*r* = sinAB, and *bz* = sinBC; hence by substitution, *b*O · *zr* = cosAB · cosBC – sinAB · sinBC. By using the same notation as before, we have cos(A + B) = $\frac{\text{cosA} \cdot \text{cosB} - \text{sinA} \cdot \text{sinB}}{r}$ = (if $r = 1$) cosA · cosB – sinA · sinB, which is the known formula for the cosine of the sum of two arcs.

The same construction will answer for the two remaining cases: for if we suppose that *b*E and *bc* are two arcs, then will *c*E be their difference, and *zr* the sine of *c*E, as proved above; hence *zr* (= sin(*b*E – *bc*)) = $\frac{br \cdot \text{O}z - \text{O}r \cdot bz}{b\text{O}}$. But *br* = sin*b*E, and O*r* = its cosine; and *bz* = sine *bc*, and O*z* = its cos., hence if *b*E be denoted by *a*, *bc* by *b*, and O*b* as before, then will sin(*a* – *b*) = $\frac{\sin a \cdot \cos b - \sin b \cdot \cos a}{r}$ = (if $r = 1$) sin*a* · cos*b* – sin*b* · cos*a*. Again, AB + BC is the complement of DC or *c*E; hence by the first part of the above investigation, *xy* = sin(AB + BC) = cos*c*E: but *xy* or sin(A + B) = cos(*a* – *b*) = $\frac{\text{sinA} \cdot \text{cosB} + \text{sinB} \cdot \text{cosA}}{r}$; and as sinA or AB = cosBD = cos*b*E, O*x* = cosA or AB = sinBD = sin*b*E, B*y* = *bz* = sin*bc*, and O*y* = O*z* = cos*bc*, we shall have, by substitution, cos(*a* – *b*) = $\frac{\cos a \cdot \cos b + \sin a \cdot \sin b}{r}$, = (if $r = 1$) cos*a* · cos*b* + sin*a* · sin*b*. [426]

From what has been said it appears, that if A and B be any two arcs, of which A is the greatest, then

$$\text{Sin}(\text{A} \pm \text{B}) = \frac{\text{sinA} \cdot \text{cosB} \pm \text{sinB} \cdot \text{cosA}}{r};$$

$$\text{Cos}(\text{A} \pm \text{B}) = \frac{\text{cosA} \cdot \text{cosB} \mp \text{sinA} \cdot \text{sinB}}{r}.$$

When the radius *r* is supposed = 1, the denominators in these formulæ disappear. In the latter, A and B are used for *a* and *b*, for the sake of homogeneity. The propriety of this is manifest; for as *a* and *b* denote two indefinite arcs, the same reasoning will apply to A and B, as to *a* and *b*, the first being supposed in each case the greatest.

The following Diophantine Problem was proposed for solution some months ago in a Periodical Journal, which has since been discontinued. To those who are interested in speculations of this nature, we presume that the following solution, forwarded by Professor STRONG, of Hamilton

College, will not be unacceptable.

PROBLEM.

To find three positive rational Numbers, x, y, and z, such that $x^2 - y$, $x^2 - z$, $y^2 - x$, and $y^2 - z$ may all be squares.

Assume $x - ay$ for the root of the square $x^2 - y$: then $x^2 - y = (x - ay)^2$, whence $x = \frac{a^2y + 1}{2a}$. In like manner, by assuming $x - bz$ for the root of the square $x^2 - z$, we find $z = \frac{2bx - 1}{b^2}$. But $y^2 - x = y^2 - \frac{a^2y + 1}{2a}$, (since $x = \frac{a^2y + 1}{2a}$); and as this is to be made a square, assume $y - c\left(\frac{a^2y + 1}{2a}\right)$ for its root; whence, by proceeding as before, we find $y = \frac{2a + c^2}{4ca - a^2c^2}$. But $x = \frac{a^2y + 1}{2a}$ = (by substituting for y its value) $\frac{a^2 + 2c}{4ca - c^2a^2}$. Again $z = \frac{2bx - 1}{b^2}$ = (by substituting for x its value) [427]

$$\frac{2b\left(\frac{a^2 + 2c}{4ca - c^2a^2}\right) - 1}{b^2} \text{; hence}$$

$$y^2 - z = \frac{\left(\frac{2a + c^2}{4ca - c^2a^2}\right)^2 \times b^2 - 2b\left(\frac{a^2 + 2c}{4ca - c^2a^2}\right) + 1}{b^2}$$

(by substituting for y and z their values;) and as this also is to be made a square, assume for its root $\frac{be - 1}{b}$. Then we shall have

$$\left(\frac{2a + c^2}{4ca - c^2a^2}\right)^2 \times b^2 - 2b\left(\frac{a^2 + 2c}{4ca - c^2a^2}\right) + 1 = (be - 1)^2$$; from which, by reduction,

$$b = 2 \times \frac{e(4ca - c^2a^2)^2 - (a^2 + 2c)(4ca - c^2a^2)}{e^2(4ca - c^2a^2)^2 - (2a + c^2)^2}.$$

Hence the values of the required numbers are as follows: $z = \frac{2bx - 1}{b^2}$, (in which the value of b is to be found from the last equation,) $x = \frac{a^2 + 2c}{4ca - c^2a^2}$, and $y = \frac{2a + c^2}{4ca - c^2a^2}$.

The numbers a, c, and e, are to be so assumed that x, y, and z may come out positive. If $a = 1$, $c = 2$, and $e = 2$, then will $x = 5/4$, $y = 3/2$, and $z = 14/9$, which numbers will be found upon trial to satisfy the question. It may also be observed that c and a being positive, ca must not exceed 4; but the form of the above expressions for x, y, z, will be sufficient to direct us how a, c, and e, are to be assumed.

 [428]

Art. XXI. *An Account of several Ancient Mounds, and of two Caves, in East Tennessee, by* Mr. John Henry Kain, *of Knoxville.*

(Communicated for the American Journal of Science, &c.)

Mounds.

On the plantation of Mr. John Kain of Knox county, near the north bank of the Holston River, 5 miles above its junction with the French Broad, is a curious collection of mounds of earth, evidently the work of art, but of an almost antediluvian antiquity, if we may form any conjecture of their age, from that of the forest which grows around and upon them. They are about half a dozen in number, and arise on about half an acre of level ground without any seeming regularity. They are pyramidal in their shape, or rather sections of pyramids, whose bases are from 10 to 30 paces in diameter. The largest one in this group rises about 10 feet above the level ground, and is remarkably regular in its figure. A perpendicular section of this mound was made about a year since, but no important discovery was made. It was found to consist of the surface thrown up, and contained a good deal of ashes and charcoal.

This group of mounds is surrounded by a ditch, which can be distinctly traced on three sides, and enclosing besides the mounds, several acres of ground. It is like the mounds covered with trees, which grow in it and about it. At every angle of this ditch, it sweeps out into a semicircle, and it appears in many respects well calculated for defence.

There are many other mounds of the same form in Tennessee. At the junction of the French Broad with the Holston, there is one in which human bones are said to have been found. Farther [429] up French Broad, near Newport, is a very large mound. It reposes on a very level and extensive plain, and is itself the largest I ever saw. It is thirty feet high, and its base covers half an acre of ground. As it ascends from its base, there is a slight inclination from a perpendicular on all sides, and the upper surface is as level as the rest is regular. From the great size of this mound, its commanding situation, and the mystery which veils its history, it is a most interesting spot of ground. There are many other mounds of this description in the State of Tennessee, but I have not visited them.

Though not immediately connected with this subject, I take the liberty to subjoin an account of a remarkable cave or grotto, in a bluff of limestone, on the south bank of the Holston River, opposite the mounds first described. The bluff is perhaps 100 feet high and 50 wide. The grotto is a large natural excavation of the rock, 60 feet high and 30 feet wide. It is very irregular, and to the very top bears marks of the attrition of waves. The river to have been so high, must have covered the valley through which it now winds its quiet way. The excavation gradually diminishes in size as you proceed backward, till at 100 feet from the entrance, it terminates. A remarkable projection of the rock divides the back part into two stories. This grotto, whose walls are hung with ivy, and the bluff crowned with cedars, and surrounded by an aged forest, on which the vine clambers most luxuriantly, viewed from the river which winds slowly around it, and reflects its image, is more than beautiful: it is even venerable. But what renders it most interesting to many visitors, is a number of rude paintings, which were, as tradition reports, left on it by the Cherokee Indians. These Indians are known to have made this cave a resting-place, as they passed up and down the River Holston. These paintings are still distinct, though they have faded somewhat within my remembrance. They consist of representations of the sun and moon, of a man, of birds, fishes, &c. They are all of red paint, and resemble in this respect, the paintings on Paint Rock near the warm springs.

Much has been said of the objects of curiosity in the country north of us; and I took the liberty to describe some of them in my preceding communication. Indeed we may say, without danger of [430] exaggeration, that the range of Alleghany Mountains presents a variety of the most curious features, and many objects of beauty and sublimity. I have noticed a few of the most prominent, but "the half is not told."

Extract of a Letter, &c.

Knoxville, Nov. 24, 1818.

I was on a visit to a friend a few days since, about 30 miles to the north of this, and was invited by him to visit an interesting curiosity in the neighbourhood. We crossed the Clynch River where it is much confined by mountains, and banks as high as mountains. Our guide conducted us to the foot of a steep declivity, where we left our horses, and with some difficulty ascended about 70 yards. Here we came to the mouth of a cave which had been stopped up by a stone wall. The wall was made of limestone and mortar, which is now harder than the stone itself. It is, without a doubt, artificial, for besides the evidence afforded by its structure, it contains bones and animal remains.

What was this wall built for? There was a tradition among the inhabitants that it contained money, and they were much disappointed on opening it, not to find any. Like other caves, it contains a variety of calcareous concretions, and I obtained some fine specimens of brown spar, which I will take the first opportunity to send you.

I remain your Friend,

JOHN H. KAIN.

N. B. This wall is 10 feet thick.

For the American Journal of Science, &c. [431]

BENJAMIN SILLIMAN, ESQ.

Dear Sir,

Should you think the facts detailed in the following statement worthy of publication, you are at liberty to publish them. The knowledge of the first, I derived in the year 1802, from a gentleman and a lady, both inhabitants of the town where the person whose case is detailed, lived: of the third in 1802, from the same lady: and of the second in 1802, from a lady, a near relative of Mrs. S. When the facts were communicated to me, I immediately committed them to writing, and to avoid mistakes, read what I had written to the persons communicating them.

I am very respectfully,
Your Friend, and obedient Servant,
BENJAMIN W. DWIGHT.

ART. XXII. *Facts illustrative of the Powers and Operations of the Human Mind in a Diseased State.*

1. Some years ago a farmer of fair character, who resided in an interior town in New England, sold his farm, with an intention of purchasing another in a different town. His mind was naturally of a melancholy cast. Shortly after the sale of his farm, he was induced to believe that he had sold it for less than its value. This persuasion brought on dissatisfaction, and eventually a considerable degree of melancholy. In this situation, one of his neighbours engaged him to enclose a lot of land, with a post and rail fence, which he was to commence making the next day. At the time appointed he went into the field, and began with a beetle and wedges to split the timber, out of which the posts and rails were to be prepared. On finishing his day's work, he put his beetle and wedges into a hollow tree, and went home. Two of his sons had been at work through the day in a distant part of the same field. On his return, he directed them to get up early [432] the next morning, to assist him in making the fence. In the course of the evening he became delirious, and continued in this situation several years; when his mental powers were suddenly restored. The first question which he asked after the return of his reason, was, whether his sons had brought in the beetle and wedges. He appeared to be wholly unconscious of the time that had elapsed from the commencement of his delirium. His sons, apprehensive that any explanations might induce a return of his disease, simply replied that they had been unable to find them. He immediately arose from his bed, went into the field where he had been at work a number of years before, and found the wedges, and the rings of the beetle, where he had left them, the beetle itself having mouldered away. During his delirium, his mind had not been occupied with those subjects with which it was conversant in health.

2. Mrs. S., an intelligent lady, belonging to a respectable family in the State of New-York, some years ago undertook a piece of fine needlework. She devoted her time to it almost constantly for a number of days. Before she had completed it, she became suddenly delirious. In this state, without experiencing any material abatement of her disease, she continued for about seven years; when her reason was suddenly restored. One of the first questions which she asked after her reason returned, related to her needlework. It is a remarkable fact, that during the long continuance of her delirium she said nothing, so far as was recollected, about her needlework, nor concerning any such subjects as usually occupied her attention when in health.

3. A lady in New England, of a respectable family, was for a considerable period subject to paroxysms of delirium. These paroxysms came on instantaneously, and after continuing an indefinite time, went off as suddenly; leaving her mind perfectly rational. It often happened that when she was engaged in rational and interesting conversation, she would stop short in the midst of it, become in a moment entirely delirious, and commence a conversation on some other subject, not having the remotest connexion with the previous one, nor would she advert to that [433] during her delirium. When she became rational again, she would pursue the same conversation in which she had been engaged during the lucid interval, beginning where she had left off. To such a degree was this carried, that she would complete an unfinished story or sentence, or even an unfinished word. When her next delirious paroxysm came on, she would continue the conversation which she had been pursuing in her preceding paroxysm; so that she appeared as a person might be supposed to do, who had two souls, each occasionally dormant, and occasionally active, and utterly ignorant of what the other was doing.

INTELLIGENCE.

Art. XXIII. 1. *Discovery of American Cinnabar and Native Lead.*

Extract of a letter from Dr. Comstock of Hartford, to the Editor.

Sir,

In answer to your inquiry concerning the discovery of sulphuret of mercury and native lead in this country, I send you the following summary of a letter I received from B. F. Stickney, Esq. Indian agent, dated Fort Wayne, Dec. 1, 1818.

Mr. Stickney states, that the situation of Fort Wayne, and the country surrounding, is a high level, probably about 800 feet above the sea. From this place the water-courses divide and take different directions, on the one hand falling into the Gulf of Mexico, and on the other into the Bay of St. Lawrence. The whole country is of secondary formation, chiefly calcareous and aluminous.

Bitumen and sulphur are every where to be found, and as usual, accompanied by the metals.

In speaking of the cinnabar, his words are, "I have found a black and garnet-coloured sand, in great abundance on the shores of the Lakes Erie and Michigan, this is a sulphuret of mercury, [434] and yields about sixty per cent. It is so easy to be obtained, and in so convenient a form for distillation, that it must become an important article of commerce."

The native lead was found on the Anglaize River, at a considerable distance from the fort.

Of this he says, "metallic lead is so interspersed with galena, as to prove incontestably the existence of native lead."

Respectfully,

Your obedient Servant,

J. L. COMSTOCK.

Hartford, Conn. Feb. 17, 1819.

Benjamin Silliman, M. D., &c.

2. *Theoretical views of Professor Hare of Philadelphia.*

We are authorized to mention, that Dr. Robert Hare has taught in his lectures during the last eighteen months, that acid properties never appearing in the absence of water, this fluid or its elements are most entitled to be considered as the acidifying principle: but that probably it does not exist in acids as water, but is decomposed when added to them, the particles of hydrogen and oxygen by their different polarities taking opposite sides of those composing the base. The extrication of hydrogen by the action of diluted sulphuric acid on iron or zinc, being the consequence of a previous, not simultaneous decomposition of water. Hence when sulphuric or nitric acids are so concentrated as to char or ignite, they are not acids really.

3. *New Work on Chemistry.*

Dr. John Gorham of Boston, Professor of Chemistry in Harvard University, &c. has published the first volume of his Elements of Chemical Science. The work will be comprised in two volumes, and its completion will be anticipated with interest by the scientific public.

[435]

4. *Botanical.*

Dr. Romer of Zurich, has begun, since 1815, to publish a new edition of the Systema Vegetabilium of Linnæus; he proceeds in its publication; it will form several volumes.

Robert Brown of London, is endeavouring to group the natural orders of plants into natural classes, or rather into larger natural orders, with determinate characters: he has communicated some parts of his labour to the botanists of Paris. He has been the first to employ as a new character in the distinction of natural orders, the estivation of flowers, or the manner in which they are folded in the buds.

C. S. Rafinesque, in his Analysis of Nature, has adopted a new practice, that of giving single substantive Latin names to the natural orders and families of plants.

Mirbel has proposed a new nomenclature of fruits in his Elements of Botany.

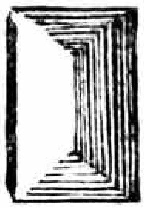
Decandolle, after publishing the principles of the science in his Theory of Botany, has begun to undertake a general species plantarum, according to the natural classification.

Three splendid Floras of the south of Europe have been undertaken. 1. Flora Græca, by Sibthorp and Smith in England. 2. Flora Lusitanica, by Link and Hoffmansegg in Germany. 3. Flora Nepolitana, by Tenore in Naples. They are very expensive works, and are not yet terminated. *Received in January, 1819.*

5. *Staurotide.*

Extract of a letter to the Editor, from John Torrey, M.D., of New-York.

"Mr. Pierce and myself lately found staurotide on the island of New-York. It occurs in considerable quantity in a rock of *mica slate*, on the banks of the Hudson, about three and a half miles from the city. The crystals very seldom form the perfect cross, though many were found, intersecting each other imperfectly at angles of 60°. Several single crystals were obtained exceedingly perfect. They were short 4-sided prisms, with the acute lateral edges truncated at each extremity on the two solid angles of the most obtuse lateral edges, forming diedral terminations at each extremity of the prism. The faces of these terminations were inclined to each other at an angle of 67° and a few minutes. The annexed figure shows the form of the crystal." [436]



6. *Supplement to the "Remarks on the Geology and Mineralogy of a Section of Massachusetts, on Connecticut River, &c." contained in No. 2, Art. I, of this Journal, by* E. Hitchcock, A. M.

The following minerals, found in the region above named, were either omitted in the former list, or have been noticed since that was made out.

Bog-iron Ore. In Greenfield and Warwick.

Hornstone. Rare; in Deerfield and Conway.

Silicious Slate. In rolled pieces, on the banks of Deerfield river; not abundant.

Basanite, or *Lydian Stone*. Same locality.

Augite. In an aggregate of greenstone, quartz, and calcareous spar, in the greenstone range, Deerfield. Colour black, and the crystals usually imperfect, or broken.

Staurotide. In mica slate, Northfield, one mile east of the village, on the turnpike to Boston. The crystals observed were six-sided prisms. The same rock contains reddish garnets.

THE LEVERETT RANGE OF GRANITE.

This name is given to a granite range that emerges from the puddingstone near the centre of Amherst, and extends northerly, with some interruption, nearly thirty miles, through Leverett and Montague to Northfield. And, indeed, there is some reason to suppose that it again appears to the north of Northfield. The range is widest in Leverett, where its breadth is more than a mile. It is noticed in the "Remarks," No. 2, Art. I, of this Journal, and may be seen on the section [437] accompanying that communication. But on further examination it has been found to be more extensive than was supposed. The texture of the rock is coarse. Plates of mica, 3 or 4 inches across, are common in it; and one specimen of a beautiful blue feldspar, the fragment only of a crystal, measured in one direction 8 inches.

Two circumstances in this range give it an interest in the eye of a geologist. The one is its proximity to sandstone and puddingstone; and the other, its small elevation in comparison with the surrounding rocks of later formations. In some places no other rock could be found lying between the granite and puddingstone; though the soil prevented my observing whether there is an actual contact. But in general there is a stratum of mica slate a few rods wide between these rocks, and not unfrequently gneiss lies between the mica slate and granite.

Standing on this range in Leverett, you have on the west, at about 100 rods distant, a precipitous mountain of sandstone and puddingstone, five or six hundred feet higher than the granite. On the east, a mile or two distant, a mountain of sienite gradually rises to a still greater height than the puddingstone; and on the southwest, at nearly the same distance, you can see an alluvial formation. In general this granite does not rise so high as the adjacent rocks, whether secondary or primitive.

VEINS OF ORE IN THIS GRANITE.

1. *Of Galena in Leverett.*

This ore forms a narrow vein in the southwest part of the town, on land of Moses Smith, two miles from the Congregational meeting-house. The direction of the vein is nearly north and south, and where I saw it, only a foot wide. The gangue is sulphate of barytes.

2. *Of Galena, Copper Pyrites, and Blende.*

This vein is a little more than a mile north of the one above described, and it may be a continuation of the same vein. The gangue is nearly an equal admixture of sulphate of barytes [438] and quartz; and galena and sulphuret of copper are disseminated through it in about the same, that is, equal proportions. The blende, which is of a yellowish aspect when the fractured crystal is held in a certain position, appears only occasionally. This vein is several feet wide, has been wrought to a small extent in two places, and its direction is nearly north and south. It is on land of Mr. Field.

Radiated quartz. In the above vein. A considerable tendency to crystallization appears at this place, not only in the quartz, but in the foliated structure of the barytes.

Brown spar. In the same place. But little of this mineral was noticed. It exfoliated before the blowpipe, turned black, and became magnetic.

3. *Of Specular Oxide of Iron in Montague.*

This is found in a partially detached eminence, 100 feet high, near the north line of Montague, on land of Mr. Taft, a little southwest from the confluence of Miller's river with the Connecticut. The whole hill, not less than 100 rods in circumference at its base, is traversed by numerous veins of this ore; and scarcely a foot of the rock is to be seen that does not contain these, varying in width from a mere line to several inches. The principal vein appears on the top of the hill; and is, as nearly as I could determine, not less than ten feet wide, lying in a north and south direction. The ore seems to be abundant, and generally pure. Masses, that have been separated by blasting, and weighing from 100 to 200 pounds, lie on the surface. A small proportion of sulphuret of iron was observed in some specimens. The gangue is quartz, and the walls and hill granite.

No opinion is here intended to be offered concerning the probable value of these ores, if worked. If they be useless to the present generation, they may not be so to some future one, when labour shall be cheaper; and therefore it was thought to be of some consequence to point out their localities.

In the remarks, to which this paper is a supplement, *blue quartz* was inadvertently put down among the minerals found in Deerfield. I presume it does not exist there. It is also probable that [439] the variety of garnets found in Conway, is not, as formerly stated, the melanite.

7. *New Process for Tanning.*

A process for effecting the tanning of leather in a neat, expeditious, and thorough manner, has been discovered by a Mr. Steel, of Connecticut: some account of it may be given hereafter.

8. *Connexion between Chemistry and Medicine.*

This subject has been discussed in an able and interesting manner by Professor Cooper, of Philadelphia, in a public discourse, which has now been some months before the public.

9. *Brucite.*

A new Species in Mineralogy, discovered by the late Dr. Bruce. We hope to publish in the next Number a description and analysis of it.

10. *Lithography.*

We are promised for our next Number, a full account of this art, of which we have received a beautiful specimen, *A Minerva*, executed by Mr. Bates Otis, an ingenious and enterprising artist of Philadelphia, who, under the patronage of Dr. Samuel Brown, is preparing to disseminate the productions of his skill, and to make this important art (executed with American materials,) extensively useful in this country.

N. B. As this number has already much exceeded its proper size, we are obliged to suppress many articles of domestic, and all those of foreign intelligence.

CONCLUSION.

In the prospectus of this work, the expectation was expressed that each Number would contain from 64 to 80 pages; that as many as four Numbers might be issued within the year, and engravings were promised for such subjects as might require them.

The Numbers published, have actually contained from 104 to 132 pages, the four have been issued within a period of ten months, and twelve copper-plate engravings and several woodcuts, illustrate the present volume.

Of the subjects proposed in the plan of the work, our pages contain notices, more or less extensive, of Geology, Mineralogy, Botany, Zoology, Chemistry, Natural Philosophy, Mathematics, Useful Arts, Fine Arts, Inventions, Reviews, Biography, and Intelligence. How far then we have redeemed our pledge, we leave it for our readers to decide.

In the commencement of an enterprise, for the first time attempted in this country, an enterprise arduous in its nature and uncertain in its issue, it will not be doubted that considerable solicitude was experienced.

To concentrate American efforts in science and the arts, by furnishing a Journal to record their proceedings, will, in our view, not only have a direct influence in promoting the honour and prosperity of the nation as connected with its physical interests, but will also tend in no small degree to nourish an enlarged patriotism, by winning the public mind from the odious asperities of party. That entire success will attend our efforts, it would perhaps be presumptuous to expect, but we trust that the interesting previous question, whether such a work can be adequately sustained, by appropriate materials, may be considered as now decided. The support which we have received, and for which we are deeply grateful, has been far beyond our most sanguine hopes, and has caused us to dispense with no small portion of those less important efforts of our own, with which we were prepared to succour our infant undertaking.

If we may be allowed to express a wish relative to the nature of future communications, it [441] would be, that those of a scientific nature should not be diminished, while those relating to the arts, to agriculture, and to domestic economy, should be increased; we particularly solicit the communications of practical men, versed in the useful and ornamental arts, and they will be acceptable should they not even be clothed in a scientific dress.

Arrangements have been made for the reception of an increased number of the best European Journals, both from the continent and from Britain; they have already begun to arrive, and we hope to give in future numbers, more full details of foreign scientific intelligence, although it is true that this species of information has hitherto been stinted, not from poverty of materials, but from the pressure of original American communications.

In justice to the publishers of this work, we add, that *this publication is an expensive one*; very heavy advances have been already made by them, while only a trivial amount has been received in return. It is hoped, therefore, that subscribers will promptly remit, *free from postage*, the small stipulated sum, and also make the required advance for the succeeding volume. This last is not due till the first number of that volume has been issued, but it would save postage to remit both sums at once, and thus also it will be known what subscriptions are continued. In a subscription so widely dispersed over a large portion of the United States, an inattention to *punctual payment*, must soon put in hazard the existence of a work, having otherwise the fairest prospects of continuance, and we hope of usefulness.

Should this appeal be promptly answered, the first number of the next volume (already in considerable forwardness,) will be published in the course of the summer; and should men of ability continue to furnish communications, and *the public be willing to pay for the work*, it is our [442] wish to publish future numbers with greater frequency, and to complete our volumes whenever we are prepared, without confining ourselves to particular periods of time.

New-Haven, Conn. May 17, 1819.

POSTSCRIPT.

American geological society.

We have the pleasure to announce, that an American Geological Society has been recently organized by an association of gentlemen, residing in various parts of the United States. An Act of Incorporation, conferring the necessary powers, has been granted by the Legislature of Connecticut, and farther accounts of the plan and progress of the Society may be expected in future numbers of this work.

FOOTNOTES:

[46] See Number 1. page 59.

[47] The proper name of these prairies, and of one of the places where they are found, being illegible in the MS, we were obliged to omit those names; we believe however that the sense is not injured.—*Editor.*

[48] Former orthography, *Toghconnuck* and *Toghconnuc*. That of the text deviates farther from the *Indian*, but is later and preferable.

[49] See Map.

[50] If this memoir should ever meet the eye of this amiable man, I trust he will excuse the notice to which his labours so justly entitle him. To him we are indebted for a complete science of crystallography, and for having determined the existence and limit of species, which mineralogists had not obtained, and chemists could not determine. He has devoted a long life to the improvement of science, and it is his praise, that he has preserved the meekness of religion amidst the most flattering success. Our scientific countrymen, who have visited Paris, have been particularly indebted to him; and this notice is, in their behalf, both the tribute of justice and gratitude.

[51] *Mr. Nuttall* will excuse me for retaining *my own specific name*. His knowledge of this plant was derived from my Herbarium, where he found it under the name of *tripsacum cylindricum, Mich*? Although it can hardly be the plant of *Michaux*, it was so considered by the late *Dr. Muhlenberg*, when specimens were first communicated to him. It remains under this name in his Herbarium, but is not included in his *work on the grasses*. He left it for me to describe along with other new and doubtful plants from the south.

[52] This is the specific name found in my Herbarium by *Mr. Nuttall*, under which it had been previously transmitted to Mr. Elliott. *Vid. Nuttall's North American Genera*, v. I. p. 83.

[53] *Mr. Nuttall* was probably deceived from having examined the *spikes* before they were fully evolved.

[54] Mr. Stephen Elliott has confirmed the description of Aublet, in his Botany of the Southern States. (Received January, 1818. *Editor.*)

[55] I refer the scientific reader for further particulars to "*An account of a storm of Salt*, which fell in January, 1803. By Richard Salisbury, F.R.S. L.S." in the Transactions of the Linnæan Society of London. Vol. VIII. p. 207-10.

[56] Linnæan Transactions. Vol. VIII. p. 289.

[57] P. 339. Lond. ed.

[58] Maintained by Dr. Mitchill.

[59] My friend, Dr. John Torrey, has favoured me with the following results of some experiments, which he made at my request upon the last snow which fell. "A pint and a half of snow water was reduced by evaporation to a few drops. On testing this with vegetable blue infusions no alteration of colour took place. It was afterward evaporated to dryness, and about a quarter of a grain of a solid residuum was obtained. This was redissolved in a small quantity of pure rain water, and prussiate of potash added to it, without occasioning any precipitate. Nitrate of silver produced a white precipitate so copious, that the solution was thick with it. Carbonate of soda produced no effect. The transparency of a solution of muriate of barytes was not disturbed by it. These experiments prove, that a *free acid* does not exist in snow water, but that the muriate exists in it combined with an alkali, which is most probably soda."

[60] Mr. J. Murray, of London, considers this to be a mistake. *Free muriatic acid*, and not muriate of soda, he says, will be found in the recipient.—*Elements of Chemistry.* Part I. p. 212. Lond. ed. 1818.

[61] That is, in those oaks which grow near the salt water, the branches that directly face the sea do not attain so great size and strength as those on the opposite side; this has also been observed on the south side of Long-Island.

[62] Volney's Travels in Syria and Egypt. Vol. I. p. 48. Perth ed.

[63] Volney's Travels in Syria and Egypt. Vol. I. p. 217.

[64] Darwin's Botanic Garden. P. 256.

[65] To prove that salt is absorbed into land plants growing near the sea, the following facts, for which I am indebted to my friend, Dr. D. V. Knevels, are conclusive. The fruit of those cocoa-nut trees which grow near the seashore in the West-Indies is generally found to have a saltish taste; and even the milk in the nut is perceptibly impregnated with it. Those trees on the contrary which grow in the interior, beyond the influence of salt water, have their fruit perfectly fresh and sweet.

The same gentleman informs me, that in a plantation of his father's, in the West-Indies, situated on the seashore, a whole crop of the cane was rendered unfit for the purpose of making sugar, in consequence of the great quantity of salt which it had imbibed.

[66] Journal of Science and the Arts. No. X.

[67] Volney's Travels in Syria and Egypt, Vol. I. p. 167.

[68] On the subject of the Egyptian ophthalmia, it may be asked "why it does not appear in innumerable other situations, equally exposed to salt air, as Cape Cod, and the West-India Islands?" To this it may be replied, that in the production of any disease whatever, a *predisposing* state of the system is as necessary as an *exciting* cause. This predisposition appears to exist in a great degree among the Egyptians, and depends upon the nature of their climate, their habits, and mode of living, all of which have a tendency to produce *debility* of the eyes, and thus render them more susceptible of the impression of those causes which excite inflammation.

[69] Rush's Medical Observations and Inquiries, Vol. II. p. 132.

[70] Volney's Travels, Vol I. p. 226.

[71] Rush's Observations and Inquiries, Vol. II. p. 133.

[72] This was most remarkably perceived on one occasion, where, under the idea that possibly chrome might exist in the ores, they had been intensely heated in a forge along with pearl ashes. The mass, when lixiviated, gave only a greenish solution, becoming colourless by nitric acid, and again greenish by an alkali; this was supposed to be owing to iron and manganese. No metal was obtained, except a few minute globules of attractable iron, but the laboratory was filled with white fumes, having the peculiar odour alluded to.

[73] Several of the facts, we are aware, accord with the properties of bismuth, between which and tellurium there are several strong points of resemblance, but a number of other facts appear irreconcilable with the properties of that metal, and of every other except tellurium.

[74] Excepting, that the covers ought to be so depressed, as that their brims may be lower than the bottoms of the interior vessels over which they are placed respectively. This is necessary to prevent the gas from escaping, ere it have access to the surface of the fluid beneath those bottoms.

[75] The apparatus may also be made of glass bottles, duly proportioned, and cut (truncated) alternately near the shoulder and near the bottom.

[76] In whose Journal it was ordered to be printed, but, to prevent delay, it was published, by the Author, in a separate paper, and forwarded by him to the Editor of this Journal.

[77] Possibly the electric fluid causes decompositions when emitted from an impalpable point (as in the experiments of Wollaston) because its repulsive agency is concentrated between integral atoms, in a mode analogous to that here referred to; a filament of water in the one case, and of wire in the other, being the medium of discharge.

[78] The conclusions are drawn from experiments made by the electricity of the Voltaic apparatus.

[79] Especially to Dr. T. P. Jones, and Mr. Rubens Peale, who remember the suggestion.

[80] See Plate. Fig. 3.

[81] This evidently differs from the common mode of decomposing the fixed alkalies by galvanism: there the effect depends on electrical attractions and repulsions—here on the chemical agency of ignited iron produced *extemporaneously* in the galvanic circuit: this mode of operating appears to be new. *Editor.*

[82] The glasses may be had by applying to Edw. A. Pearson, No. 71 Cornhill, Boston.

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TRANSCRIBER'S NOTE

Four illustrations have been moved from their book location to be close to the text describing them. One from page 289 to p293; another from p413 to p337; another from p414 to p423; another from p448 to p91.

Obvious typographical errors and punctuation errors have been corrected after careful comparison with other occurrences within the text and consultation of external sources.

Except for those changes noted below, all misspellings in the text, and inconsistent or archaic usage, have been retained. For example, knifeblade, knife-blade; New England, New-England; carbonat, carbonate; musqueto; illy; chesnut; connexion.

Pg 2, 'these scources' replaced by 'these sources'.
Pg 13, 'arch AGN .. VA' replaced by 'arc AGN..VA'.
Pg 14, 'Vth A´D´G' replaced by 'Vth A´D´G´'.
Pg 39, 'sooner, in might' replaced by 'sooner, it might'.
Pg 50, 'are two limited' replaced by 'are too limited'.

Pg 51, 'importance usally' replaced by 'importance usually'.
Pg 58, 'shall be acertained' replaced by 'shall be ascertained'.
Pg 60, 'Geology of the the' replaced by 'Geology of the'.
Pg 77, '20th of Ferbuary' replaced by '20th of February'.
Pg 90, 'than elswhere;' replaced by 'than elsewhere;'.
Pg 91, 'convenient mothod' replaced by 'convenient method'.
Pg 94, 'heretofore peccolated' replaced by 'heretofore percolated'.
Pg 104 Footnote [16], 'by inadventence' replaced by 'by inadvertence'.
Pg 108, 'aud three feet' replaced by 'and three feet'.
Pg 113, 'Some has' replaced by 'Some have'.
Pg 133, 'tress; insects' replaced by 'trees; insects'.
Pg 138, 'three huudred feet' replaced by 'three hundred feet'.
Pg 147, 'quantitites of sandrock' replaced by 'quantities of sandrock'.
Pg 149, 'is is not a proper' replaced by 'is not a proper'.
Pg 158, Illustration caption, 'P. IV' replaced by 'Pl. IV'.
Pg 171, 'much of the gelantine' replaced by 'much of the gelatine'.
Pg 173, 'empyxeuma arising' replaced by 'empyreuma arising'.
Pg 204, 'unknown to to all' replaced by 'unknown to all'.
Pg 238, 'Honsatonuck River' replaced by 'Housatonick River'.
Pg 247, 'Inis, low' replaced by 'Iris, low'.
Pg 249, 'Yacca filamentosa' replaced by 'Yucca filamentosa'.
Pg 257, 'eleven apicial' replaced by 'eleven apical'.
Pg 261, 'the tripple series' replaced by 'the triple series'.
Pg 269, 'situation of of the' replaced by 'situation of the'.
Pg 285, 'my own observatiou' replaced by 'my own observation'.
Pg 290, 'thrown purmiscuously' replaced by 'thrown promiscuously'.
Pg 308, 'for sometime made' replaced by 'for some time made'.
Pg 315, 'chrystallography of Haüy' replaced by 'crystallography of Haüy'.
Pg 315, 'in cold weather.' replaced by 'in cold water.'.
Pg 316, 'common iron pyrytes' replaced by 'common iron pyrites'.
Pg 344, 'regular octaedrons' replaced by 'regular octahedrons'.
Pg 345, 'Hill in Cattskill' replaced by 'Hill in Catskill'.
Pg 346, 'The schorl crucifom' replaced by 'The schorl cruciform'.
Pg 359, 'Deerfield, Massachuchusetts,' replaced by 'Deerfield, Massachusetts,'.
Pg 363, 'Humingbirds arrived' replaced by 'Hummingbirds arrived'.
Pg 367, 'American hazle' replaced by 'American hazel'.
Pg 370, 'been unusully warm' replaced by 'been unusually warm'.
Pg 371, 'and mullin' replaced by 'and mullein'.
Pg 409, 'appear irreconcileable' replaced by 'appear irreconcilable'.
Pg 415, 'inerposed agents' replaced by 'interposed agents'.
Pg 416, 'corruscating flame' replaced by 'coruscating flame'.
Pg 429, 'to many visiters' replaced by 'to many visitors'.

Index:
'Diplocœa barbata, 282.' replaced by 'Diplocea barbata, 252.'.
'Localites' replaced by 'Localities'.
'Rafinesque', 'on Diplocœa barbata, 352' replaced by 'on Diplocea barbata, 252'.
'Slate', '70—342.' replaced by '70, 342.'.
'Torrey' page number '437' added.