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BENJAMIN SILLIMAN, M. D. LL. D.

Professor of Chemistry, Mineralogy, &c. in Yale College, Corresponding Member of the Society of Arts, Manufactures, and Commerce, of London; Member of the Royal Mineralogical Society of Dresden; of the Imperial Agricultural Society of Moscow; Honorary Member of the Linnæan Society of Paris; of the Natural History Society of Belfast; and Member of various Literary and Scientific Societies in America.

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INTELLIGENCE AND MISCELLANIES.

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ERRATA FOR VOL. XIII.

Page 335 lines 4 and 18 from bottom, for *Peperine* read *Piperine.*
" 329 bottom line, for *Livourne* read *Leghorn.*
" 330 line seven from bottom, the same.

THE

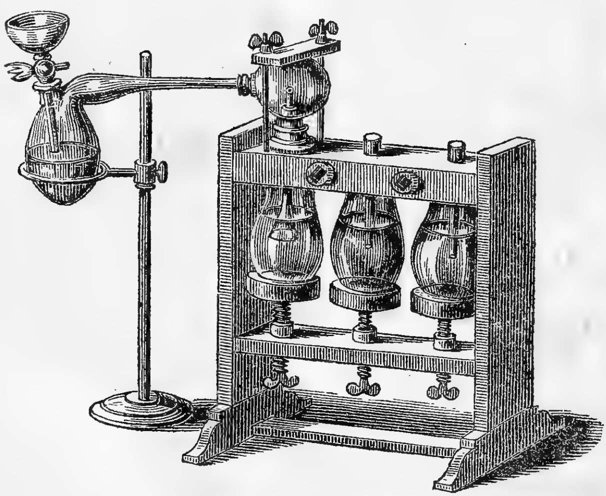
AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*Miscellaneous Contributions, descriptive of apparatus and inventions; by* R. HARE, M. D. &c. &c. &c.

APPARATUS FOR REGULATING OR PROMOTING ABSORPTION.

1. *Vases tightened by screws, substituted for Woulfe's bottles.*



IN the apparatus represented in the preceding figure, the vessels, containing the liquid to be impregnated, are, by the pressure of screws, made tight against leaden plates, which they are ground to fit, and which are cemented and nailed to the wooden cross-piece under which the vessels are situated.

Into the cross-piece two horizontal holes are bored, and burned with a wire, from a common orifice, so as to enter, severally, other holes bored vertically, of which one communicates, internally, with the first, the other with the second vessel. The external orifice being closed, by a screw, a communication is established between the cavities of the vessels, which obviates the necessity of tubes, as in ordinary apparatus. The second vessel, communicates with the third vessel, in the same way as with the first.

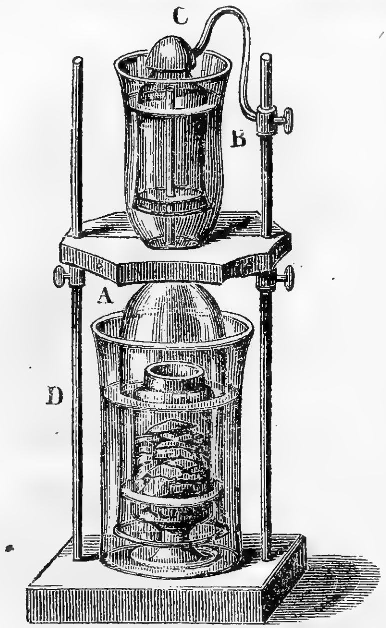
The hole over either vessel, which communicates with the inside of the preceding vessel through the wooden perforation, is furnished with a tube passing downwards, a few inches, so as to enter any contained liquid. The tube, thus immersed in the first vessel, rises into and communicates with the cavity of the globe. This globe is pressed by screws against a lead plate, which it is ground to fit, so as to make an air tight juncture, in the same way, as already described, in the case of the vessels, below the cross-piece.

Hence the first tube establishes a communication between the globe, and the liquid in the first vessel, below the surface of which its trumpet-shaped orifice reaches. The second tube, communicating by means of the perforations made in the wood, with the cavity of the first vessel, descends into the liquid contained in the second vessel. The third tube, in like manner, communicating with the cavity of the second vessel, descends into the liquid of the third vessel.

The gas, extricated from the retort, passes into the receiver, where it deposits any condensible matter, and proceeds down the tube into the first vessel. Whatever gas is not there absorbed, proceeds through the diagonal perforations, in the wood, to the tube in the second vessel, escaping from that into the liquid. The excess of gas beyond what is there taken up, reaches the third vessel from the second, as it reached this from the first.

2. *Apparatus for regulating the supply of a gas, by its absorption.*

Two open-necked bell glasses, A, B, are joined neck to neck, so as to be inverted as respects each other. From the cavity of the lower one a pipe leads up through the axis of the upper one. The lower bell which is the largest, is situated within a large cylindrical vessel of glass, D, so as to include a jar, with a perforated stem or pedestal. Over the



opening in the pedestal, some irregular fragments of glass are laid, so as to furnish support to some carbonate of ammonia, subsequently introduced into the jar. Suppose the upper inverted bell, B, to be supplied with a solution of pearlash, and another smaller uninverted bell glass, C, placed within it, so as to include the pipe proceeding from the bell, A, below. If, while the apparatus is thus situated, diluted nitric acid be poured into the cylindrical glass vessel, D, it will rise into the jar containing the carbonate, and cause it to give out carbonic acid gas. This gas will at the same time press with equal force upon the surface of the acid in the glass cylinder below, and upon that of the alkaline solution in the upper bell C.

If the atmospheric air of the vessel be allowed first to escape by a hole at C, (closed or opened by a screw omitted in the figure) so that the carbonic acid may reach the alkaline solution undiluted with air, it will of course be gradually absorbed, generating bicarbonate of potash. Should the absorption thus arising, be too slow to take up the carbonic acid as fast as it is evolved by the reaction between the acid and the carbonate, the alkaline solution will be depressed within the bell glass, C. At the same time the pressure within the larger bell glass increasing proportionally, the height to which the acid reaches in the jar is diminished, and of course the re-action with the carbonate lessened, until the quantity of carbonic acid evolved by it, be commensurate with the absorption by the solution in the upper part of the apparatus. Should the solution become saturated, the depression of this solution in the bell C and of the acid in the jar D, must go so far, as that the acid no longer reaching any portion of the carbonate, the evolution of gas from it must cease.

3. Illustration *of the cold consequent to* Rarefaction : *or* Relaxation *of* Pressure.

Cold and cloudiness arising from rarefaction.

Incipient rarefaction, in the air of a receiver, is usually indicated by a cloud, which disappears when the exhaustion has proceeded beyond a certain point. A delicate thermometer placed in the receiver, shows that a decline of temperature accompanies this phenomenon. We may therefore infer, that the cloud is the consequence of refrigeration. But, in the present state of our knowledge, it is nearly as difficult to account for the disappearance of heat, as for the appearance of the cloud. This phenomenon, in common with many others, must be referred to those unknown peculiarities which determine the capacities of substances for caloric. By rarefaction the capacity of air for caloric, becomes greater than that of the aqueous vapor which it contains. This vapor being consequently deprived of it, condenses into a fog. The aqueous particles, receiving heat subsequently from the surrounding medium through the receiver, and air pump plate, are vaporized again; and of course, cease to be visible, in the form of a cloud.

Cold produced by the palm glass.

Two bulbs are formed, at each end of a tube, one having a perforated projecting beak. By warming the bulbs, and plunging the orifice of the beak into alcohol, a portion of this fluid enters, as the air within contracts, by returning to its previous temperature. The liquid, thus introduced, is to be boiled in the bulb which has no beak, until the whole cavity of the tube, and of both bulbs not occupied by liquid alcohol, is filled with its steam.

While in this situation, the end of the beak is to be sealed, by fusing it in a flame excited by a blowpipe.

As soon as the instrument becomes cold, the steam which had filled the space within it, vacant of alcohol in the liquid form, condenses, and a vacuum is produced; excepting a small proportion of vapor, which is always emitted by liquids when relieved from atmospheric pressure.

The well known instrument, thus formed, has been called a palm glass; because the phenomena, which it displays, are seen by holding one of the bulbs, in the palm of one of the hands.

When thus situated, the bulb in the hand being lowermost, an appearance of ebullition always ensues in the bulb, exposed to view, in consequence of the liquid, or alcoholic vapor, being propelled into it, from the other bulb subjected to the warmth of the hand.

This phenomenon is analogous to the case of ebullition in vacuo, or the culinary paradox; but the motive for referring to the experiment here, is to advert to the fact, that as soon as the last of the liquid is forced from the bulb, in the hand, a very striking sensation of cold, is experienced by the operator.

This cold is produced by the increased capacity of the residual vapor for caloric, in consequence of its attenuation. The analogy is evident between this phenomenon and that above described, both being attributable to the increase of capacity for caloric, resulting from a diminution of density.

Relaxation of pressure.

It is immaterial whether the diminution of density, arise from relieving condensed air from compression, or from subjecting air of the ordinary density to rarefaction. A cloud similar to that which has been described as arising in a receiver partially exhausted, may usually be observed in the neck of a bottle recently uncorked, in which, in consequence of its generation by fermenting liquor, a quantity of gas has been evolved disproportionable to the space.

4. *Apparatus for shewing that when pressure is relaxed the capacity of air for heat and moisture is increased.*

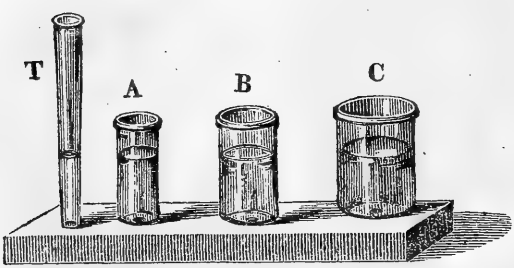
This figure represents an instrument which I have employed to illustrate the influence of compression, on the capacity of air for caloric and moisture.

A glass vessel with a tubulure and a neck, has an air thermometer fastened air tight by means of a cork into the one, while a gum elastic bag is tied upon the other, as represented in this figure. Before closing the bulb, the inside should be

moistened. Under these circumstances, if the bag, after severe compression by the hand, be suddenly released from pressure, a cloud will appear within the bulb, adequate in the solar rays, to produce prismatic colors. At the same time the thermometer will show that the compression is productive of warmth—the relaxation of cold.

The tendency in the atmosphere to cloudiness, at certain elevations, may be ascribed to the rarefaction which air inevitably undergoes, in circulating from the earth's surface to such heights.

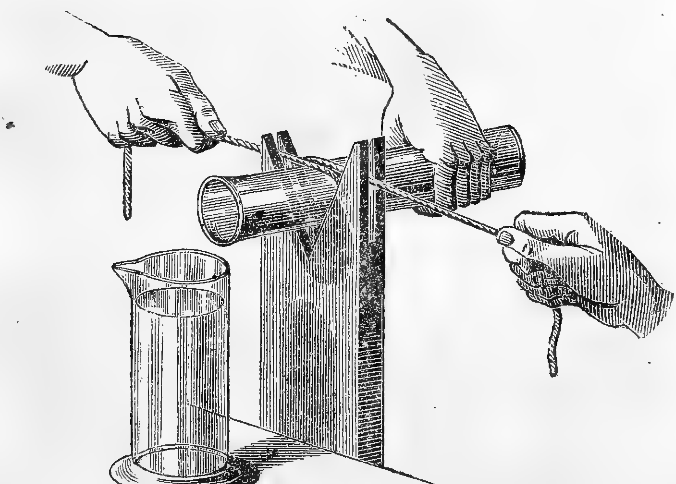
5. Apparatus *for* Illustrating Capacities *for heat.*



Let the vessels A, B and C be supplied with water through the tube T. The water will rise to the same level in all. Of course the resistance made by the water in each vessel to the entrance of this liquid will be the same, and will be measured by the height of the column of water in the tube T. Hence if the height of this column were made the index of the quantity received by each vessel, they would all have received the same quantity. But it must be obvious, that the quantities severally received, will be as different as are their horizontal areas. Of course we must not assume the resistance exerted by the water within the vessels against a further accession of water from the tube, as any evidence of an equality in the portions *previously* received by them.

In like manner, the height of the mercury in the thermometer, shows the resistance which substances, whose temperatures it measures, are making to any further accession of caloric: but it does not demonstrate the quantities, respectively received by them, in attaining to the temperature in question. This varies, in them, in proportion to their attraction for this self-repellent fluid; as the quantities of water received by the vessels A, B, C, are varied in the ratio of their respective areas.

METHOD *of* DIVIDING GLASS, *by* FRICTION.



Some years ago, Mr. Lukens showed me, that a small phial, or tube, might be separated into two parts, if subjected to cold water, after being heated by the friction of a cord made to circulate about it by two persons alternately pulling in opposite directions. I was subsequently enabled to employ this process, in dividing large vessels, of four or five inches in diameter, and likewise to render it in every case more easy, and certain, by means of a piece of plank forked like a bootjack—as represented in the preceding figure; and also having a kerf, cut by a saw, parallel to, and nearly equi-distant from, the principal surfaces of the plank, and at right angles to the incisions, productive of the fork.

By means of the fork, the glass is easily held steady by the hand of one operator. By means of the kerf, the string while circulating about the glass is confined to the part, where the separation is desired. As soon as the cord smokes, the glass is plunged in water, or if too large to be easily immersed, the water must be thrown upon it.—This method is always preferable when on immersing the body, the water can reach the inner surface. As plunging is the most effectual method of employing the water, in the case of a tube I usually close the end which is to be immersed.

RATIONALE.

If the friction be continued long enough, the glass though a very bad conductor of heat, becomes heated throughout in the part, about which the friction takes place; of course, it is there expanded; while in this state, being suddenly refrigerated by cold water on the outside only, the stratum of particles immediately affected contracts, while that on the inside not being chilled, undergoes no concomitant change. Hence a separation usually follows.

Art. II.—*Rejoinder of Dr. Hare to the criticisms of Prof. Olmsted, with strictures on the singular opinion, that attraction of gravitation emanates from the sun, as heat does from ignited carbon.*

In the last number of the American Journal of Science, Professor Olmsted alleges that I have committed an oversight in making Davy's hypothesis "wear a much more *mechanical aspect*" than it did originally, and in "applying to it principles which have no bearing on it whatever."

According to Johnson's Dictionary, mechanics is the geometry of motion, a science which shews the effect of powers, or moving forces, so as they are applied to engines, and "*demonstrates the laws of motion.*"

The phenomena of heat being by Sir H. Davy ascribed to motion, how can my arguments, shewing that they are not agreeable to the laws of motion, make that hypotheses unduly "*wear a mechanical aspect*," or subject it to an application *of principles* "*which have no bearing on it whatever?*"

In his first critique, the author alleged Davy's reasonings to be "*idle*" because they were "*mechanical.*" In the critique before us, I am condemned for treating them as "*mechanical.*"

A sufficient answer to this objection, was afforded in my essay in the following language:

"It may be said that this motion is not measurable upon mechanical principles. How then I ask, does it produce mechanical effects? These must be produced by the force of the vibrations, which are by the hypothesis mechanical: for whatever laws hold good in relation to moving matter in mass, must operate in regard to each particle of that matter. The effect of the former, can only be a multiple of that of the latter. Indeed one of Sir Humphrey Davy's reasons for attributing heat to corpuscular vibration, is, that mechanical attrition generates it. Surely then a motion produced by mechanical means, and which produces mechanical effects, may be estimated on mechanical principles." See Vol. IV, page 144 of this Journal.

"In the hypothesis, (says Professor Olmsted,) the motions supposed, are those which occur between particles of matter, and at insensible distances. In the refutation, the principles applied are such as belong to those motions which occur between masses of matter, and at sensible distances."

The laws which regulate the production, or transfer, of motion, being established as respects any given mass, or quantity, can the division of it into two parts, ten parts, or a million parts, or into any possible number of parts, or particles, render those laws inapplicable? The same argument may be opposed to his distinction between sensible and insensible distances, as if a law could cease to operate in consequence of the spaces being too small for our vision!!!

Since a whole can be no more than a multiple of its parts, a law cannot be true of motion, in any given distance, which does not hold good with respect to any part of that distance.

The minuteness of the distances within which movements can take place, in solids, is cited by me, as a potent objection to ascribing to intestine motion the expansive power imparted by them, when heated, to vaporizable substances, as in the case of water converted into steam by hot iron; but if such phenomena do result from intestine motion, and if the transfer of expansive power, be a transfer of such motion, however insensibly small may be the spaces in which it occurs, however minute the atoms concerned, how otherwise can they be regulated, than by the same laws which are found to hold good in the case of larger spaces, and larger masses.

Professor Olmsted proceeds:

"The motions contemplated by the hypothesis, are either rotatory, or vibratory; those supposed, in the refutation, are rectilinear, and in one continued direction; for to no other does the law of percussion adduced apply."

As this allegation is unsupported by any proof, it can have but little weight. I will however throw my opinion into the opposite scale. I do assert that the law, which I have laid down, is universally applicable where motion is communicated, from one moving body, or set of bodies, to another body, or set of bodies, whether the movements be vibratory, rotatory, or rectilinear.

If while two planets are revolving, or two pendulums vibrating, one overtake the other, will not the heavier be least altered from its previous motion? If two wheels, two globes, or two cylinders, while rapidly rotating, were to come into contact, would not the same law prevail?

"The refutation, (says Professor Olmsted,) supposes the particles to come into collision, each upon each; whereas the hypothesis does not warrant the supposition that any two particles ever strike against each other at all. For it is plain that the revolutions of particles round their own axes, do not bring them into collision with each other, nor do the vibrations of the particles make it necessary to suppose that they ever hit each other; for if there be space enough between the particles to permit them to vibrate at all, it is clear that they may vibrate without coming into collision."

"Finally, if they did impinge against one another, it must be remembered that the motion is backwards and forwards, and therefore this is not a case to which the law of percussion, as adduced by Dr. Hare applies."

"I cannot but think therefore that Dr. Hare has refuted a consequence, not of Sir Humphrey Davy's but of his own creating."

It were obviously as absurd to allege, that particles cannot move without coming into collision, as to assert that the bow of a violin cannot move unless it rub against the strings. Yet as in the one case, friction is necessary to produce music, so in the other, collision is indispensable to keep the particles asunder. Would the diurnal movements of the planets prevent them from falling into the sun? Their annual motion has this effect, by generating a centrifugal force; but it cannot be imagined that in every mass, expanded by heat, the particles, by revolving about a common center of gravity, generate a centrifugal force which, counteracts cohesive attraction; and thus, enables them to exist at a greater distance from each other.

When by the affusion of hot water upon mercury, the temperature of the latter is raised, how can the velocity of the vibrations in which temperature consists, according to the hypothesis, be increased in the last mentioned liquid, without collision between the mercurial and aqueous atoms? While they remain asunder, the particles can have no influence upon each other, unless through the medium of some inherent property of attraction, or repulsion. Of the former, motion is the opponent, of the latter the substitute, by the premises.

If motion be not productive of a collision among the particles, in what way can it enable them to sustain that remoteness, in their respective situations, which expansion requires? It cannot be supposed that they will become either reciprocally repulsive, or less susceptible of cohesive attraction, merely in consequence of their undergoing a vibratory movement.

Professor Olmsted had evidently a very imperfect recollection of the design, or execution of my essay, when he wrote his critique; or he could not have denounced it as idly employing, in chemistry, those mechanical reasonings which it was intended to explode. In the last number of the Journal, I devoted a page to the exposure of his error, in speaking of my essay as intended to prove the materiality of heat, although described as remarks made in opposition to Davy's hypothesis. In the article now under consideration, he repeats this error in the following words:

"In the year 1822, Dr. Hare published an essay aiming to prove that caloric, or the cause of heat, is a material fluid."

I never wrote an essay of which this is a correct description. It did not appear to me expedient to recapitulate all the various well known arguments in favor of a material cause of calorific repulsion. To explain the phenomena of heat, but two hypotheses had been suggested, one ascribing them to caloric, the other to motion. The object of my essay was mainly to shew, that motion could not be the cause of heat, and I only incidentally introduced some direct arguments in favor of a material cause.

I shall proceed to give other instances of the precipitancy of Professor Olmsted, in adopting the unfavorable impressions of my essay with which he occupies the pages of the American Journal of Science. The existence of repulsion and attraction as properties of matter, being referred to, as self-evident, and their co-existence as properties of the same particles, shewn to be inconceivable, I assumed, that there must be a "matter in which repulsion resides, as well as a matter in which attraction resides."

This induces Professor Olmsted to make the following inquiry:

"Does Dr. Hare maintain that the attraction which bodies exert, resides in a kind of matter extrinsic to the bodies themselves?"

It would be impossible, I think, to give a better answer to this query than is afforded by the following words of my neglected essay, words contained in the very next paragraph below that, which has given rise to Professor Olmsted's embarrassment.

"Substances endowed with attraction make themselves known to us by that species of this power which we call gravitation, by which they are drawn towards the earth and are therefore heavy or ponderable, by their resistance to our bodies, producing the sensation of feeling, or touch; and by the vibrations or movements which they excite in other matter, affecting the ear with sounds, and the eye by a modified reflection of light."

Will the Professor, after reading this sentence, require any further information respecting the kind of matter in which attraction resides, pursuant to my view of the subject? Independently of this sentence, *which I deem it unjustifiable in him to have neglected*, I do not know how he could take up the idea, that I considered the matter, in which attraction resides, as any other than that, usually recognised as matter, by people of common sense. Does my allegation that there must be as *many* kinds of matter as there are incompatible properties, convey the idea, that there must be *more* kinds of matter than there are of such properties?

Founding injudicious inferences with respect to my opinions upon errors, arising from his own inattention, the Professor proceeds:

"I have met with no late writer who has taken it for granted that there is matter in which attraction resides, distinct from the bodies themselves, which exert this influence on each other. But if Dr. Hare is not thus to be understood,—if he do not mean to assert such a doctrine, then why does he conceive it necessary to suppose a fluid upon which the phenomena of repulsion depend,—in which the self-repellent power resides, distinct from the bodies themselves, which exhibit such repulsion ?"

I have said that the particles of ponderable matter obviously possess the power of mutual attraction; they cannot then be endowed at the same time with reciprocal repulsion. But if they cannot be endowed with repulsion, why should they be endowed with attraction? says my antagonist.

If I were to allege the whiteness of a thing as a reason why it could not be black, would any person in his senses say, but if it cannot be black, how can it be white? Does the presence of attraction prove the absence of attraction, because it proves the absence of repulsion?

Since there is no permanent quality observed in the particles of ponderable matter, inconsistent with their exercising attraction, and as it would be unphilosophical to suppose more causes than are necessary to explain the phenomena, so it would be unreasonable to ascribe their attractive power to an extraneous principle. I allude here to attraction of cohesion, or gravitation. That chemical affinity is much under the influence of the electric fluid, is now generally admitted. But to return to the critique.

" *Will Dr. Hare explain the fact that caloric sometimes increases the attraction of bodies for each other?* " What would he say of the fact, that the attraction of two gases, is sometimes increased by heat?"

I will not undertake to explain that, which does not occur. When a mixture of hydrogen and oxygen gas, is heated, it expands. So long as expansion continues, it is obvious that caloric does not increase attraction. At the temperature of ignition the heterogenous particles combine, and an explosion ensues.

Thus at the same moment that the simple atoms unite, the compound atoms, formed by their union, separate explosively. The elevation of temperature does not therefore increase attraction, it only favors the union of heterogenous particles, by some unknown process. In a mixture of hydrogen and oxygen gas, the caloric with which they are severally combined, may attach itself to both poles of each simple particle; after their union, to only one pole of each simple particle;

and of course, to two poles of the compound particle forming water. Elevation of temperature may favor this change by its mysterious influence on the electric polarities of the particles; as in the case of the tourmaline :—or because the enlargement of the calorific atmospheres, renders the preservation of their independency more difficult.

That caloric is alternately an exciting cause of combination, and decomposition, we all know. Mercury is oxydised at one temperature, and revived at another. At one temperature hydrogen yields chlorine to silver, at another, decomposes the chloride of that metal. At a low temperature, potassium absorbs oxygen more greedily than carbon, or iron, while the reverse is true, when these are heated to incandescence. I have long suspected that heat promotes and modifies chemical action, by influencing electrical polarities. The elements of water are severed by the voltaic poles. If in this case their polarity is influenced in one way, elevation of temperature, when it causes their reunion, must have an opposite effect, and of course must influence polarity.

I suppose in this case a change in the attractive power of the poles, of combining atoms, analogous to that which may be induced in iron bars, which attract or repel each other accordingly as the magnetism communicated to their poles, is alike or unlike.

Platina sponge, a cold metallic mass, is found to cause the union of the hydrogen and oxygen in a gazeous mixture: yet it is utterly inconceivable that the presence of inert particles, combining with neither of the elements of water, can cause an increase of attraction between them.

That the phenomena just alluded to, belong to a department of chemistry, with which we are but imperfectly acquainted, I admit; but on that very account inferences, founded on them, ought not to be allowed to invalidate the demonstration, of which the existence of a material cause of heat is, upon other grounds, susceptible.

Professor Olmsted cannot discover that there is

"Any more difficulty in conceiving why a heated body should communicate its influence to another body without the aid of air, than *why the Sun should communicate his attractive influence to Saturn or Uranus without the aid of such a medium*" ! ! !

It would seem then that Professor Olmsted is of opinion, that the planets owe their power of attracting each other, and all the bodies on or near their surfaces to the Sun, as they owe their light; and that his removal from the system would simultaneously involve them in darkness, and destroy the reciprocal attraction between them, and their satellites. This is a glaring error. The reaction between the Sun and planets, is reciprocal, arising from a quality inseparable from either, and which admits of no increase, transfer, or diminution.

If the Sun did "*communicate his attractive influence*" to the other bodies in the solar system, I should be unable to say why he might not communicate any other property. The transmission of heat, in vacuo, is analogous to the radiation of light not the reciprocal influence of gravitation. If the illumination of Saturn or Uranus, could be explained without supposing the existence of a material fluid, I grant that the passage of heat in vacuo ought to admit of a similar explanation.

But as it is to me inconceivable, and contradictory to the obvious meaning of the word, to suppose the existence of a property without matter to which it may belong; so it appears impossible that there can be a transfer of a property, effected through a space otherwise void, without a transfer of matter.

The following paragraph was written in opposition to the *hypothesis of motion*, it is noticed by Professor Olmsted, as if intended directly to *support* the *materiality* of *heat*, as the reader will perceive by his remarks which I shall also quote.

"As in order for one body or set of bodies in motion to resist another body or set of bodies in the same state, the velocity must be as much greater, as the weight may be less, it is inconceivable that the particles of steam should by any force, arising from their motion, impart to the piston of a steam engine the wonted power; or that the particles of air should prevent a column of mercury, almost infinitely heavier, from entering any space in which they may be included by beating it out of the theatre of their vibratory, and rotatory movements."

"Has not Dr. Hare plainly fallen into a mistake here? It evidently is not heat which moves the piston of a steam-engine, but it is the elastic force of steam. "But, it may be asked, is not that elasticity caused by heat?" True; but the effect is not the same thing with the cause."

Was ever an inquiry more irrelevant? Where have I said that heat does move the piston of a steam-engine. In the paragraph above quoted which gives rise to the inquiry, I have only argued that motion produced among the aqueous particles, by the heated boiler, cannot move the piston. In order to shew that I have committed a mistake "*here*," it must be proved that *it is conceivable that the particles of steam should by a force arising from their motion, impart to the piston the wonted power*, or that particles of air, should, in like manner, "*support a column of mercury infinitely heavier.*"

It evidently would be absurd to suppose that the piston of a steam engine could be propelled, by the direct influence of caloric, without the intermediate effect of the elasticity of vapor.

The author combats strange opinions, peculiar to his own imagination, as if I were answerable for them.

"It is difficult, says Professor Olmsted, to see why heat should impart such a wonderful power to steam; nor does our supposing it to be a material *fluid* diminish this difficulty." He might with equal propriety add, it is difficult to understand how light can impart to the objects around us, the wonderful property of conveying their images to the sensorium; nor does the idea of a material fluid, passing from them to the retina of the eye, diminish the difficulty.

It is difficult to understand why lead should be heavy; nor does the idea, that the earth attracts it, diminish the difficulty.

My mind is much less embarrassed by supposing a cause, where I observe an effect. Wonderful as it is, that the earth should by solar attraction be kept in its orbit, to me it is much less wonderful than if there were no Sun to attract it; wonderful as it is that all the phenomena of vision should be due to the reflection, refraction, or polarization of a subtile matter emanated from every luminous point in the creation, the phenomena in question appear to me far less perplexing, than when I endeavor to dispense with the agency of a material cause. The opposite properties of the tenacity of ice, and the explosiveness of steam, however surprizing, are less so when considered as belonging to different kinds of matter, than when I suppose them alternately assumed by the same particles, so as to cohere at one time, and at another fly apart, with violence, without any cause for the change.

It seems to me, that without the special interference of the Creator, the properties of any species of matter must always remain the same. Should any property appear to cease, or to be varied, there must be an accession, or an avolation of matter differently endowed, from that in which the change is observed.

"Has not Dr. Hare committed a mistake in understanding Sir Humphrey Davy to assert that heat is motion; whereas, his doctrine is, that motion is the cause of *heat.*"

The author forgets that the word heat is used to signify a cause as well as an effect; when I have spoken of motion as substituted for heat, I meant that it was substituted for the cause of sensible heat. The phenomenon which we call sensible heat, is the effect of motion according to one hypothesis of caloric, or latent heat according to the other. It appears, therefore, that when correctly examined, the definition which I have given of Davy's hypothesis is the same as that which the author sanctions.

To conclude, I regret that instead of having only to encounter difficulties inherent in the subject, I should be obliged to occupy so many pages in refuting criticisms, respecting which, I can *sincerely say in the author's own language*, that they are "*idle*," and have "*no bearing whatever*" upon the subject, which has called them forth.

Art. III.—*Observations and Experiments on Opium; by* George W. Carpenter, of Philadelphia.

OPIUM.

Its varieties and appearance in commerce, &c.

This important article, from its extensive usefulness, in modifying and alleviating the most afflicting and painful diseases, incident to human nature, merits perhaps the most conspicuous place in the materia medica, and yet from the frequent abuse by injudicious administration, and more particularly, from improper pharmaceutical preparations, produces many injuries and distressing consequences. It is therefore an important inquiry to discover the causes of these inconveniences. For this end I have made a series of experiments, and am happy to submit the result, in the following observations. Before however, immediately entering upon the pharmaceutical preparations, it may not perhaps be improper to offer a very concise view of the *natural history* and physical characters of this article, as it occurs at the present day in our commerce.

Opium is the product of the Papaver Somniferum, and is the inspissated juice of the capsules of that plant. It has been improperly termed a gum by many authors and the error prevails to the present day. It is a native of the southern parts of Asia, it may however be raised in our gardens and is now cultivated in England on an imposing scale, and increasing for several years. It possesses the same properties as the Turkey or East India opium, and is more pure, containing a larger proportion of soluble matter. The Turkey opium has hitherto possessed the best reputation and has been considered superior to any other. Dr. Thomson* informs us, that he obtained nearly three times more morphia from the Turkey opium, than was yielded by the same quantity of East India. I have treated equal quantities of Turkey and English opium by the same process, and obtained twenty per cent. more morphia from the latter than the former; this would sanction a superiority in favor of the English, which I believe it possesses, and which I think is to be attributed to the careful manner in which it is prepared.

The following are the prominent characters of the several varieties of opium, by which they may be easily distinguished.

Turkey opium is of a reddish brown colour possessing a strong narcotic odour, of a solid and compact consistence, when dry has a shining and uniform fracture of a dark brown colour, producing a reddish brown powder; the best kind is generally in flat pieces.

East India opium is of thin consistence, sometimes almost like that of honey; when dry it is more friable, its colour nearly black and possesses less bitter and a more nauseous taste than the *Turkey;* it has a strong empyreumatic odour, and not the narcotic heavy odour which is so sensible in the Turkey; it is considerably cheaper but much inferior in strength to the latter, and according to Dr. Thomson, contains but one third the quantity of morphia, and a larger proportion of narcotine, which renders it a far less desirable article. Dr. Coxe, in his valuable American Dispensatory, remarks, that one eighth the cakes is allowed for the enormous quantity of leaves with which they are enveloped. This opium is little used in this country and is seldom if ever to be found in the shops of our druggists.

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* London Dispensatory.

English opium is generally in smaller cakes, frequently thin and flat, of a more permanent consistence, of a clear smooth fracture and is in a great measure destitute of leaves, stalks, and other impurities which generally accompany the preceding varieties. It has the general character of being superior in quality to the Turkey opium which chemical analysis* has determined. The quality of opium differs materially, even that from the same country, climate and soil. This arises, no doubt in many instances, from the manner in which it is prepared and cultivated. It is frequently found in our market mixed with leaves, stalks, seeds, &c. and from the great proportion of these admixtures in some opium, it would lead to the conjecture that the leaves were worked in when the opium was in a very soft and recent state, for the purpose of increasing its weight and the degree of its consistence. I have seen opium whose external characters possessed all the features of superior quality, and when broken, exposed a large proportion of the leaves and capsules of the poppy, which although it does not alter the particular effects, must diminish the activity of the opium in direct proportion to the quantity and weight of these extraneous and insoluble matters, and I have ascertained by careful experiments that the

* It is to chemistry that we are indebted for many important facts in relation to opium, and for the knowledge of the nature of morphia, and narcotine, the two active principles of opium, thus disclosing a very singular fact, that principles of a directly opposite nature exist in the same substance, and exercise individually their particular effects on the constitution. This entirely subverts several hypotheses which had been framed to account for the modus operandi of this medicine. Many are opposed to chemical analysis as a correct mode of discovering the virtues of medicines particularly vegetable substances. Dr. Young among others was of this opinion, and stated as an argument to support his doctrine, that Geoffroy discovered by chemical analysis that the soporific quality of opium depended upon the sulphur which it contained. (See Young on opium.) We might agree with Dr. Young, if the science of chemistry was in no greater advancement than in the times alluded to, and did experiments upon opium now lead to similar conclusions, we might as well reject as useless, the analysis of cinchona because a chemist has asserted that the comparative quantities of the active principles (quinine and cinchonine) yielded by the Carthagena bark were in proportion to the quantity yielded by the Calisaya as one to seventy. If errors so palpable as these would have retarded the spirit of investigation, or diminished the zeal of the scrutinizing chemist, the science, instead of holding the high reputation it now possesses, would long since have dwindled into obscurity. We must however expect that some errors and absurdities will creep into every department of science.

quantity of soluble or extractive matter by the same menstrua and process, yielded by different parcels of opium, varied from four and a half to five and six drachms in the ounce.

The consumption of opium is almost incredible. In the year 1800, 46,808 pounds were consumed in Europe, and the quantity has been increased largely every year since. In 1809 the revenue which the Bengal government derived from the sale of *opium* was £594,978 and the exports of opium from Calcutta to China alone in 1811—12, amounted to 4,542,968 Sicca Rupees, £567,871* The supply of Calcutta for 1827 is rated as follows:

Bengal, - - - -	6,570 chests.
Mahia, - - - -	4,000 "
do. smuggled, - - -	1,500 "
Turkey, - - - -	1,000 "
	13,700 chests.

The supply for 1826 was 10,300 chests making an increase of 3,400 chests in the last year.

The speculating spirit in this article at Calcutta is at present said to be in a depressed state, which is attributed to the large supply, but is perhaps produced still more, by the scarcity of the circulating medium.

Although opium is prohibited by the Chinese government, yet about 2000 chests are annually imported into Canton the average sale price being 1200 dollars per chest making the amount annually expended by Canton for this drug the enormous sum of 2,400,000 dollars; about 40,000 pounds are annually imported into London.

In the provinces of Bahar and Benares, among the most productive of the East Indies, the common product of opium is 24 pounds to an acre, besides which the cultivator reaps about forty pounds of seeds. The preparation of the raw opium is under the immediate superintendence of the company's agent, who adopts the following method to prepare it. It consists in evaporating by exposure to the sun, the watery particles, which are replaced by oil of poppy seeds to prevent the drying of the resin. The opium is then formed into cakes, and covered with the petals of the poppy, and when sufficiently dried, it is packed in chests with the fragments of the capsules, from which the poppy seeds have been

* Hamilton's East India Gazetteer.

threshed out. It is said opium is sometimes vitiated with an extract from the leaves and stalks of the poppy and with the gum of the mimosa.

The cultivation of opium in England if pursued extensively will influence the price of the article in our market.* It has lately been cultivated more successfully by a Mr. Young than any other person who has yet attempted its culture in Great Britain, and from which more flattering expectations are entertained of its success. Dr. Coxe however in his standard work, the American Dispensatory, observes it is apprehended that the climate of Great Britain will be an insuperable obstacle to its becoming a profitable branch of agriculture. It has been obtained in the United States where this objection will not prevail.† I think the southern states, particularly the Carolinas and Georgia are admirably adapted, from climate, soil, &c. for the cultivation of the poppy, and this plant if properly managed, would no doubt become a source of considerable profit to the cultivator, if not an immense revenue to the states and a most important addition to the productions of our country.

The opium raised in England, has been used for several years by physicians and surgeons, who pronounce it superior to the best Turkey and East India opium. One thing is very certain, it is prepared with more care and attention, and is more free from leaves and other impurities. The fracture of English opium, when dry, is as smooth and uniform as that of liquorice. What I have seen has been put up in small flat

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* Messrs. Cowley and Stains of Wainslow in the season of 1822 raised 143 pounds of excellent opium from 11 acres and 5 poles of land, for which they received a premium from the society instituted at London for the encouragement of arts, manufactures and commerce. A medal has been given by the society to J. W. Jeston, Esq. surgeon, for an improvement in collecting the juice of the poppy, which consists in collecting it immediately after it exudes from the capsules instead of allowing it to be inspissated on the capsule. The capsule is scarified with a sharp instrument guaged to a proper depth, when the juice is scraped off with a kind of funnel form scoop, fixed into the mouth of a vial, when one vial is filled, the scoop is removed to another, and the juice is evaporated in shallow pans; some varieties are much more productive than others. (See transactions of the society of manufactures and commerce, vol. 41.)

Mr. Ball in 1796, received a premium from the society for the encouragement of arts for a specimen of British opium little inferior to the oriental. (Transactions of the society of arts, vol. 14, 260, 270.)

† Philadelphia Medical Museum, Vol. II, page 428.

cakes and is of a good consistence. Opium is frequently put up in a soft state and packed with a large proportion of leaves to prevent the lumps from adhering together, these leaves adhering to the sides are gradually taken into the body of the opium, which with those previously incorporated with it, constitute the impurities already described.

Observations and experiments on the Pharmaceutical preparations and constituent principles of Opium; by George W. Carpenter.

Extract of Opium.

One of the advantages which the extract of opium possesses over the crude opium of commerce, is, that all the fœculencies and impurities having been separated, we obtain the soluble and active portion of the opium, in a pure state, and as the insoluble and impure parts produce no effect, and constitute a considerable proportion of the bulk and weight, the opium of commerce must differ in proportion to the amount of these impurities, and consequently cannot be depended upon so well as the extract for activity or uniformity of strength. The extract of opium, as it is generally made, is very objectionable, not being more active than crude opium, and consequently is seldom or never employed by our physicians. From various modes and different menstrua which I have tried, I find the following to make the most eligible preparation, possessing most advantages both in the activity and persistency of the extract, as well as having a decided superiority over crude opium, by affording all its desirable effects, without any of its inconvenience or disadvantages.

Denarcotized acidulous extract of opium.

Digest one ounce of coarsely powdered opium in one pound of sulphuric æther of the specific gravity .735 for ten days,* occasionally submitting it to a moderate heat in a water bath; distil off the æther and add fresh portions until it ceases to take up narcotine or act at all upon the opium, which may be readily known by dropping a little on a clean pane of glass which will leave no trace when the opium is completely exhausted. The second or third distillation will prove sufficient,

* When it is necessary to prepare it in haste, less time may be employed by subjecting the æther more frequently to the temperature of ebullition.

and most of the æther may be saved, if prepared with care and in a proper apparatus. Professor Hare recommends the digestion of the opium in æther, to be performed in the Papins digesters; submit the opium thus treated to the action of spt. vin. Rect. eight ounces, acid acetic pur. one ounce,* aquæ seven ounces, and digest for seven days, filter and evaporate in a water bath to the consistence of an extract; this in fact will be an impure acetate of morphia, possessing most of the advantages of that valuable medicine. One ounce of the best Turkey opium yielded by this process six ounces of extract. Laudanum and other preparations may be made of the usual standard, calculating six ounces of the extract equivalent to one ounce of opium.

Denarcotized acidulous tincture of opium.

Digest one ounce of coarsely powdered opium in one pint of sulphuric æther specific gravity .735, for ten days, occasionally submitting it to the influence of a moderate heat, until it ceases to act upon the opium, separate the opium and dry it, then digest in spt. vin., rect. eight ounces, acid acetic fort. two ounces, aquæ three ounces, for seven days and filter. This preparation will be found to possess great advantages over laudanum, and the black drop of the shops, to which it will be much preferred, inasmuch as it will be deprived of the stimulating principle (narcotine) which produces such distressing effects, and frequently prevents the administration of opium, where it might otherwise be extremely useful; the addition of acetic acid will contribute much to increase the calming or sedative effects which are most generally desired, and for which opium is particularly given. By its union with morphia, it forms in solution the active sedative salt of opium, (acetate of morphia,) and differs only from the solution of the acetate of morphia of the shops in its state of purity, and as the extraneous matter with which it is associated has no effect on the animal system, it may be considered as good an article, and should be preferred for general use in consequence of being much less expensive. As this preparation will always possess uniform strength, and a like proportion of opium, it certainly deserves a conspicuous place among our pharmaceutical preparations, and is justly entitled to supersede, entirely, the common black drop

* Acid pyroligneous, pure.

of our shops, which is a very uncertain preparation, differing every where in activity, from the indefinite and vague manner in which it is directed to be made, to say nothing of the worse than useless articles which enter into its composition, such as yeast, nutmegs, and saffron.* The black drop owes its superiority over laudanum to the acetic acid in its composition, and to that alone, and it will be admitted by those conversant with these materials, that acetic acid exercises a most powerful influence in modifying the effects of opium, and I can account for it in no other way than by its union with the morphia; which being thereby rendered more soluble this union will consequently facilitate or produce its effects, which are directly sedative in place of the stimulating

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* It is a circumstance of a singular nature that so imperfect and unscientific a preparation, should so long have maintained a place in our materia medica. I believe there is no formula for the most innocent compound in the pharmaceutical catalogue, so extremely indefinite in describing the mode of its preparation, and allowing so great a scope to the judgment of the operator. In the first place, the vinegar containing the opium, nutmeg, and saffron is directed to be boiled to a proper consistence. The activity of the preparation will consequently be subject to as much variation as the ideas of persons may differ in relation to what is termed a proper consistence, and while one person after evaporating perhaps one-eighth of the menstrua would consider it of proper consistence, another might think it necessary to reduce it one-fourth, and a third might even conceive that one half was the right consistence, and the strength of the preparation would consequently be subject to a like enormous variation. In the second place, we are directed to digest for seven weeks, and then place in the open air until it becomes a syrup. We cannot see the propriety of digesting so long a time, if it be at all necessary, when the menstruum if not saturated with opium by the previous boiling, has at least taken up all its soluble matter. Exposing it to the air until it becomes a syrup, is subject to as many objections as boiling to a proper consistence, and is almost as indefinite. The consistence of a syrup is of no fixed standard, but differing from a thin fluid to the density of honey. It is lastly directed to be bottled and a little sugar to be added to each bottle. What quantity is meant by a little sugar, and what size the bottles are to which it is to be added, we are left to surmise; the strength of the preparation will of course be diminished and subject to variation, in a ratio with the quantity which each individual may think proper to add, to say nothing about the worse than useless addition of sugar to what is already a syrup. We think an article so active as the black drop should be prepared with more care, and particular and specific directions given for the mode of its preparation. A very ingenious essay upon this subject is given by Mr. Thomas Evans, in the journal of the Philadelphia College of Pharmacy.

effects of opium in its natural state. The Persians and others who make use of opium to excess, frequently swallow draughts of vinegar immediately after the opium. Dr. Crump observes, that when a patient finds himself in a distressed situation, he has recourse to a piece of opium as big as his thumb, and immediately after, drinks a glass of vinegar; this throws him into a fit of laughter and every extravagance of mirth, and frequently terminates in death.

To make the denarcotized extract, it has been recommended by M. Robiquet to make a watery infusion of the opium and to evaporate the aqueous solution to the consistence of thin honey; which is to be digested in æther instead of using the powdered or shaved opium, (as described in the above and in Dr. Hare's formula given in the preceding number of this journal.) I consider this a worse than useless expenditure, for the æther will act fully as well, if not more readily, upon opium in powder, than upon an extract containing water, and it is generally admitted, at least by the best authorities, Coxe, Thomson, and Paris, that the narcotic powers of opium are impaired by boiling in water, under exposure to air. Hence it is that the officinal preparation, opium purificatum, which formerly was highly recommended, is found to be no better than crude opium, perhaps even less active, from which circumstance it has become almost obsolete, and is rarely to be found in our shops. Under this article, Dr. Coxe in his American Dispensatory very justly observes, that in consequence of the changes which opium undergoes, by solution and subsequent evaporation (alluding to the opium purificatum,) well selected species of crude opium are to be preferred to this preparation. I cannot see the object or any advantages to result from making a watery extract, as the opium deprived of narcotine will be quite as subject to the action of proof spirits or any other menstrua with its fœculencies, as the crude opium. We do not make a watery extract of opium in the preparation of laudanum, and it would be quite as necessary in this as in the former case. Besides, water is not the most eligible menstruum for the solution of the active matter of opium. Morphia is sparingly soluble in water and the meconiate nearly the same; we therefore obtain but a portion of the sedative principle, as a part of the morphia will remain with the fœculencies undissolved, a less active preparation will therefore be made, but with more labor and expense than by submitting at once the crude opium to the action of æther, and the residue to proof spirits, as in the above formula, which the addition of acetic acid is admirably adapted to improve, by rendering the morphia more soluble, and consequently more active, in the same manner and nearly in the same ratio, as sulphuric acid united with quinine, which, by increasing its solubility, renders it much more active and efficient. Dr. Thomson, speaking of morphia, observes, that in its uncombined state, being scarcely soluble in water, or in the fluids of the stomach, it does not display its properties in a striking manner when exhibited alone, but these are very striking when combined with an acid, particularly the *acetic*. I would here remark that the acetate of morphia* of the shops, is a sub-acetate and is less active than the acetate or super-acetate, which being a deliquescent salt, it is necessary to keep it in solution; it is therefore requisite in making the solution from the sub-acetate to add acetic acid rather in excess, than under neutralisation. The following is the formula I have adopted, which will make a handsome solution and is a preparation which will keep.

Sub-acetate of morphia - - - -	12 grs.
Alcohol acidulated with twelve drops of acetic acid pure (concentrated pyroligneous acid)	1 drachm.
Distilled water - - - - - - -	1 oz.

Dissolve the morphia in the acidulated alcohol, adding the water by degrees, and filter; dose of the solution from fifteen to twenty drops.

This preparation has been very successfully used by Dr. Holcombe of Allentown, and Dr. Canfield of Arneytown, New Jersey, in cases where other preparations of opium produced such distressing effects as frequently to prevent its administration. This preparation is now extensively employed, and is attended with the happiest consequences.

Narcotine.

By the following process I obtained narcotine in a perfectly pure state.

* I found in one instance the morphia, under the *name* of acetate, perfectly uncombined with acid. This would certainly have a tendency to deteriorate the activity of this valuable medicine, and also to ruin the just reputation this article has acquired; it is therefore highly important to test this salt when you administer it in substance. When in solution it must be united with acid, as morphia is insoluble in water.

Digest one ounce coarsely powdered opium in one pint of æther for ten days, frequently submitting it to ebullition in a water bath; separate the æther, and add fresh portions, until the opium is exhausted; evaporate at the common temperature of the atmosphere, by placing the ætherial solution in a salt mouth bottle, remove the stopper and cover the mouth with bibulous paper, to prevent impurities falling in, and protract the degree of evaporation; as the æther is reduced, it leaves the sides of the bottle coated with crystals of narcotine; as the solution becomes more dense the crystals enlarge and accumulate, and the bottom of the vessel is covered with large transparent crystals, accompanied with a brown viscid liquor and extract which contains an acid, resin, caoutchouc, &c.; separate these substances from the crystaline mass, and wash the salt in successive portions of cold æther, to remove the extract. After the crystals have been sufficiently washed, dissolve them in warm æther and evaporate slowly as before, when most beautiful snow white crystals of perfectly pure narcotine will adhere to the sides of the vessel; those on the sides of the bottle assume plumose and aborescent forms which being made up of delicate acicular crystals of a silky lustre, possess a most beautiful appearance. As the ætherial solution becomes more dense by a concentration of the narcotine, the crystals enlarge and the bottom of the vessel, as before, is covered with perfectly pure narcotine, assuming the rhomboidal prismatic form, with some beautiful modifications of macled crystals; the crystals at the bottom and sides approaching the bottom, are perfectly transparent, while the most minute at the top are opaque being snow white. By picking out the largest and most regular crystals, and again dissolving them and evaporating and repeating the same process, each time selecting the largest and best crystals, I obtained perfect crystals one eighth of an inch in diameter, and I believe by continuing to operate in the same manner, much larger might be obtained, as they increased by every crystalisation.

Resin, Caoutchouc, Oil and Acid.

These substances are the constituents of the extractive matter which covers the crystals, and is separated in the manner above described; on evaporation it forms an extract without signs of crystalisation. This substance possesses all the heavy narcotic odour of the opium. The narcotine, when perfectly separated from this substance has very little odour and the denarcotized extract and laudanum possess less, in fact so little that they could hardly be detected as preparations of opium by the odour ; the strong odour of the extract arises from the oil of opium which it contains. The activity of Baume's celebrated extract, is considered by Neuman to reside in the oil and resin. The acid which exists in this compound has not been sufficiently examined to enable us to say any thing definite in relation to it. The characters of the caoutchouc are very prominent. I have not tried the effects of this combination upon animals, nor have I seen a description of it, but judging merely from its sensible characters, it would appear more active than the narcotine.

Morphia.

This substance exists in opium in union with meconic acid, its action on the human body is that of a sedative, and it possesses all the advantages which we may expect to find in opium, without any of its inconveniences. Different modes of preparation have been described by Robiquet, Derosne, Choulant, Statuerner and others. Dr. Thomson gives an easy method to obtain it in a state of purity. He employs ammonia instead of magnesia, to decompose the natural meconiate, &c. (see Annals of Philosophy for June, 1820.) The sedative powers of morphia become more manifest, when combined with an acid, particularly the acetic, which arises from increasing its solubility. Morphia is very soluble in olive oil, and according to the experiments of M. Majendie, the compound acts with great intensity. I am indebted to Dr. Coxe for the following interesting history of the crystaline forms of its saline compounds.

The *Carbonate* crystalises in short prisms.

The *Acetate* in soft silky prisms, and is very soluble and extremely active, more so than any other combination of morphia.

The *Sulphate* in arborescent crystals, next in solubility to the acetate and rather less active.

The *Muriate* in plumose crystals, much less soluble; when evaporated, it concretes into a shining white plumose mass on cooling.

The *Nitrate* in prisms grouped together.

The *Meconite* in oblique prisms sparingly soluble.

The *Tartrate* in prisms.

From either of the above combinations morphia may be separated by ammonia.

The acetate of morphia is the most active preparation, and as it is a very deliquescent salt, it is extremely difficult to obtain it in crystals. Under these circumstances, the following process has been recommended to make the acetate from the morphia.

Take morphia 4 parts, distilled water 8 parts, dilute the morphia in a porcelain vessel, afterwards add acetic acid sp. gr. 1.075, (pure concentrated pyroligneous acid,) until turnsol paper becomes scarcely red by its action ; evaporate the solution to the consistence of syrup, continue the evaporation slowly either in the sun or in a stove, collect the salt and reduce it to powder.*

The sulphate is the next most active salt of morphia, and is employed where patients have been accustomed to the use of the acetate, for generally by varying the salts of alkaline medicines, their action may be kept up longer without increasing the dose too considerably. Formulas for the preparation of these salts in syrups, mixtures, solutions, &c. are given in Haydens, Formulary and Formulaire de Montpellier.

The other salts of morphia, with the exception of the citrate, tartrate and meconite have not yet been employed in medicine.

Meconic Acid,

Exists in combination with morphia, in crude opium, forming a meconite of Morphia ; it is to this salt that laudanum owes its narcotic effects. Our distinguished chemist Dr. Hare, has in the preceding number of this Journal, given an easy process for obtaining this acid; the same gentleman has also given in the same number of the Journal, a very delicate test and an easy mode of detecting minute quantities of opium in solution. It consists in precipitating the meconic acid with acetate of lead ; the meconic acid is liberated from the lead by sulphuretted hydrogen or sulphuric acid, to which add a solution of the sulphate of iron which produces a striking red colour. Professor Hare observes, that a quantity of opium not exceeding ten drops of laudanum may be detected in a half gallon of water ; his observations on the sub-

* Pharmacopeia Gallica, 1818, page 387.

ject are well worthy of the attention of the chemist and pharmaceutist.

Fœculencies, &c.

The fœculencies and insoluble matter of opium consist chiefly of the leaves, capsules and stems of the poppy; besides these however, extraneous matters are frequently found, having been fraudulently introduced to increase its weight. The insoluble matters in different parcels of opium vary from one and a half to near three drachms to the ounce.

The effects of opium are generally so well known that it is unnecessary to give a description of it.* Sometimes, how-

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*The following particular account of the effects of opium on the Turks, by Baron de Tott, will no doubt be interesting to many readers. Speaking of those who give themselves up to its immoderate use, he says, "Destined to live agreeably only when in a sort of drunkenness, these men present above all a curious spectacle, when they are assembled in a part of Constantinople called *Teriaky Tcharchissy*, the market of opium eaters. It is there that towards evening one sees the lovers of opium arrive by the different streets which terminate at the *Solymania*, whose pale and melancholy countenances would inspire only compassion, did not their stretched neck, their heads twisted to the right and left, their back bones crooked, one shoulder up to the ears, and a number of other whimsical attitudes which are the consequences of the disorder, present the most ludicrous and the most laughable picture. A long row of little shops is built against one of the walls of the place where the mosque stands. These shops are shaded by an arbor which communicates from one to the other, and under which every merchant, without hindering the passage, takes care to place a small sofa for his customers to sit on, who place themselves in succession, to receive a dose proportioned to the degree of habit and want they have contracted. The pills are soon distributed, the most experienced swallow four of these, larger than olives, and every one drinking a large glass of cold water upon it, waits in some particular attitude for an agreeable reverie, which at the end of three quarters of an hour or an hour at most, never fails to animate these machines, but they are always very extraordinary and their manners very gay. This is the moment when the scene becomes most interesting; all the actors are happy, each of them returns home in a state of total ebriety, but in the full and perfect possession of a happiness which reason is not able to procure him. Deaf to the hootings of the passengers they meet with, who divert themselves by making them talk nonsense, every one of them firmly believes himself in possession of what he wishes. They have the appearance and feeling of it, and the reality frequently does not produce so much pleasure. The same thing happens in private houses, where the master sets the example of this strange debauch. The men of law are most subject to it, and all the Dervises used to get drunk with opium, before they learned to prefer the excess of wine. There are instances of persons getting ever, it exercises very remarkable effects on the constitution, differing materially in its action on different individuals. A case is mentioned in the Archives Générales de Medicine for December, 1826, of a lady of nervous temperament, who on taking a draught in which there was half a grain of acetate of morphia, suddenly sank into a state of syncope, which continued for two or three hours; it was several times repeated at intervals of an hour or two and attended with the same results. Dr. Dewees met with an instance in which the opium invariably purged, and was in the habit of employing it as a purgative in this case in doses of two grains, purgatives not producing their usual effects; he has also met with one instance in which opium excited violent coughing, even when administered in enema. Dr. Rousseau informs me that he had a case somewhat similar to the former, (an unmarried lady of 34 years,) where opium universally acted as a purgative; the denarcotized laudanum administered by Dr. Rousseau to the same patient, did not produce this singular effect although continued for several days.* The same gentleman also informs me, that it is not unfrequent in his practice, to meet with cases in which opium will act as a purgative, and he has discovered that the addition of tartaric acid considerably increases its purgative effects.

It is stated that highly rectified æther is the only menstruum for the solution of narcotine. If so, I cannot under-

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drunk indifferently with opium or with brandy. There is a decoction made of the shells and seeds of the poppy; this the Persians call Locquenor, and they sell it publicly in all their cities as they do coffee. The Persians say it entertains their fancies with pleasant visions, and a kind of rapture; they very soon grow merry, and then burst into a laugh, which continues till they die away in a swoon. It is found by those who have a disposition for jesting, to increase that extremely. After the operation of the remedy the body grows cold, pensive and heavy, and in this dull and indolent situation it remains till the dose is repeated. It is curious to observe the countenances of those who use this decoction before it operates, and when its effects have taken place. When they come into the decoction-house they are dull, pale and languid, but as soon as the remedy begins to operate, they are quite changed, they run into all the extravagancies of mirth and laughter, and such an uproar is produced that it would be more proper to give it the name of mad-house than decoction-shop." (Crumpe on opium.)

* Dr. Rousseau has since informed me that on a further continuation of the denarcotized tincture, the purgative effects recurred, and he was consequently obliged to suspend its administration.

stand how laudanum should contain this principle, when it is prepared with nothing stronger than proof spirits, and the alcohol of this menstruum is nearly saturated by the gum, resin and other soluble matter of the opium. I am about instituting some experiments on the residue of opium, from which laudanum has been made, also on that matter which is precipitated from laudanum by long standing, and which is so extremely active in its effects; all of which I shall be pleased to submit in a future number of this journal.

The several preparations of opium as above described, may be had from Charles Marshall, Druggist, No. 221 Market street, Philadelphia.

Art. IV.—*Chemical analysis and description of the Coal lately discovered near Tioga River, in the State of Pennsylvania; by* William Meade, M. D.

In a message from Governor Clinton, to the Legislature of the State of New York, at their last session, it is observed that "Bituminous coal of good quality had been found in the State of Pennsylvania, within twenty miles of the line of this State, near Tioga River, which, when the communication with Seneca Lake shall be opened, can be delivered at Albany, by means of the Western Canal, on very reasonable terms."

On hearing of this discovery so important to the State of New York, in every point of view, I was anxious to satisfy myself of the nature and qualities of the coal, as well as to ascertain its geological situation, particularly as I had ventured in the last number of your journal to state an opinion, that the anthracites or non-bituminous coals of this country were confined to a particular district, to the east of the Susquehannah River, and were to be found exclusively in the transition formation, a class of rocks nearly allied to the primitive, and no where to be found to the west of that river.

An opportunity was soon given me to make the necessary experiments, having been favored by Mr. Knapp the proprietor of the mine with a sufficient quantity of this coal; but from the very limited mineralogical knowledge which this gentleman possesses, I have been as yet only able to learn that the country in which this coal is found is decidedly secondary, and that the veins of coal are very extensive, deposited, as is generally the case, in a series of beds of sandstone, accompanied by shale or argillaceous slate, abounding with vegetable impressions and resting on secondary limestone, containing fossil remains. It is also an important circumstance, that in the neighborhood of the coal mine is found abundance of iron ore; specimens of which I have examined, and find it to be of that species which is called iron stone or argillaceous iron ore, precisely of the same character as that which accompanies the beds of coal in England, and which is worked so extensively in that country.

The external appearance of the Tioga coal, differs so little from the well known character of the best Liverpool or Newcastle coal, that it scarce requires a description. Its color is velvet black with a slight resinous lustre, its structure is slaty or foliated, and its layers, as in the best English coal, divided into prismatic solids with bases slightly rhomboidal; it is easily frangible and slightly soils the fingers. The specific gravity is 1.287. It burns with a bright flame and considerable smoke, with a slight bituminous smell; a sort of ebullition taking place, and as the heat increases an appearance of semifusion leaving a light residue or scoria.

These characters are quite sufficient to place it in the rank of the best bituminous coal, but as it may be satisfactory to establish by experiment the quantity of carbon which it contains, upon which its most essential value depends, I submitted it to the following experiments.

It has been long since established that nitre detonates with no oily or bituminous substance until such matter is first reduced to coal, and then only in proportion to the quantity of carbon it contains; it has also been ascertained, that when the detonation ceases, it requires about fifty grains of carbon to saturate the oxygen in the nitric acid of five hundred grains of nitrate of potash; taking this rule therefore for a guide, I fused five hundred grains of nitre in a large crucible, and having reduced one hundred grains of coal into a coarse powder, I gradually projected it, in small portions at a time, into the crucible on the ignited nitre, as long as any detonation took place; observing the necessary caution that the coal was not too finely powdered, and next that it was slowly poured in, otherwise a part of it may have been projected out of the crucible by the deflagration of the nitre. Having made this experiment several times, I found that it required seventy-five grains of the coal to decompose the five hundred grains of nitre. Now as fifty grains of charcoal or of Kilkenny coal, which is nearly a pure carbon, would have been sufficient for the same purpose, it follows, that seventy-five grains of this coal contained only fifty grains of carbon ; the remainder must of course have been bitumen and ashes. It therefore appears, that 100 parts of Tioga coal, according to experiment, contain only 66.7 parts of carbon ; approximating nearly in quality to the best English bituminous coal, which averages from fifty-seven to seventy per cent. of carbon. Though it was not of much importance, yet I thought proper to ascertain the quantity of bitumen which existed in 33.3 grains, the residue after deflagration. To determine this, it was required only to ignite a certain portion of the coal on a hot iron in the air, till nothing remained but the ashes, the carbon and bitumen being entirely consumed. One hundred grains of the coal, being treated in this manner with sufficient heat, left a residuum of only 3.50 grains of brown ashes. It would not have been difficult to ascertain the nature of this earthy residuum, but as it was of little consequence, in a practical or economical point of view, I omitted it. We shall therefore now state the result of the above analysis to be as follows :

In 100 parts of coal,

Carbon	- - -	66	7
Bitumen	- - -	30	43
Earth	- - -	3	50
		100	00

It thus appears, that the Tioga coal is of an excellent quality, fully equal to the best Liverpool coal and fit for all the purposes of manufactures, but requiring to be converted into coak before it can be made use of in the smelting of iron ore, or in many other processes in metallurgy and the arts. This should be always kept in view, and is the principal distinction between it and the anthracite or non-bituminous coal of Rhode Island and Pennsylvania. Each of them have their distinctive and valuable qualities ; while the anthracites consist nearly of from ninety to ninety-seven per cent. of pure carbon, the Tioga coal contains only 66.7, the residue being chiefly bitumen, a substance which renders it extremely valuable in domestic use, and in the reverberatory furnaces, but inapplicable to many other purposes, which the experienced artist can easily comprehend.

Considering the importance of coal, as a fuel, it would seem as if nature had formed the State of Pennsylvania for a manufacturing country; every day brings to light some new discovery of this material which must sooner or later be resorted to for the purpose of manufactures. There seem to be two great coal districts in this State. We have been long acquainted with that to the west of the Susquehannah, and extending through the centre of the State to Pittsburgh, but it seems not to have been traced so far to the north of the west branch of the Susquehannah as Tioga River, where it has lately been discovered. The whole of the coal in the district to the west of this river extending to Pittsburgh, is exclusively bituminous, no other kind having been traced there. The second coal district seems to be included between the Delaware, the Schuylkill, the Lehigh, the Lackawana, and the east of the Susquehannah River. This is exclusively anthracite or non-bituminous coal, nor is it probable, from the geological character of each of these districts, that any other species will be found in either; and here it is not uninteresting to observe, the uniformity which prevails in the character of the coal formations and of their geological associations, in this country and in England; perhaps it may be said, that the same analogy prevails in every part of Europe and America. A description of the coal fields in England would answer for the coal districts of this country, whether bituminous or non-bituminous. The associated minerals, which accompany the bituminous coal in both countries, are uniformly of the same secondary character, and as far as my own observation goes, the same facts may be stated with respect to the anthracites at least in Kilkenny, which are similar to those of this country, and whose geological formation is, as in America, decidedly transition.

Art. V.—*Notice of a Meteoric Fire Ball; by the Rev.* S. E. Dwight.

To the Editor.

New Haven, June 6, 1827.

Sir,

The Meteor, of which you requested an account, appeared on Saturday evening, March 21, 1813, a little before ten o'clock. The sky was extensively overcast, yet the covering was every where thin; and in the North where the Meteor appeared, in various tracts of considerable extent, the stars were in full view. I was standing on a platform on the North side of the house, where I could survey the whole tract of sky over which the meteor passed. When the light first broke upon me, I was looking eastward, and for a moment supposed it to be a flash of very vivid lightning; but from its continuance was led almost instantly to look to the luminary whence it proceeded. The following are the observations which I made at the time with regard to it.

1. The meteor, when I first saw it, was about 35° above the horizon; and from the course of the fence near which I stood, I judged its direction, at that time, to be about N. 20° E.

2. Its figure was nearly that of an ellipse, with the ends in a slight degree sharpened or angular.

3. The length of the transverse diameter appeared to be about equal to the apparent diameter of the moon when on the meridian; and that of the conjugate, about three fourths of the transverse.

4. The color of the body resembled that of the moon, but was evidently more yellow.

5. A trail of light was formed behind it of considerable length, perhaps of ten or twelve degrees. It was broadest near the body, and decreased in breadth very slowly for about two fifths of its length; after which it was an uniform stripe of light, about as wide as the apparent diameter of the planet Venus. The direction of the tail was coincident with that of the transverse diameter.

6. The ball was much more luminous than the tail, so that the end of the ball connected with the tail was scarcely less distinct in its form than the opposite end.

7. The illumination was so powerful, that all the objects around me cast distinct shadows, though less strongly marked than when the moon is at the full.

8. Numerous sparks, of the apparent size of the smaller stars, but much more brilliant, were continually issuing from the ball of the meteor, and after descending a little distance, soon disappeared.

9. The length of time, in which the body was visible, was about eight, or possibly ten seconds.

10. A short time before its disappearance—say one or two

seconds, three much larger sparks, or luminous fragments, were thrown from the body at the same moment. Two of these were apparently as large as the planet Venus; the third was still larger. These three were the last pieces, which I saw leave the body. Their paths were at first nearly parallel with that of the meteor, yet beneath it. From this direction however, they all deviated constantly and rapidly in parabolic curves, until they seemed falling perpendicularly towards the earth. Each fragment became less and less distinct, until it disappeared. The largest of the three continued visible until it was within about 20 degrees of the horizon.

11. The meteor itself disappeared as suddenly, as if, in one indivisible moment, it had passed into a medium absolutely opaque, or as if, at a given moment, it had left the atmosphere; but a few moments afterwards there was a distinct and somewhat extensive illumination over that part of the sky for about a second, as if the light of the departing luminary had been reflected from some unknown surface to the earth.

12. When the meteor disappeared, it was about 30° above the horizon, and as I judged from the course of the fence, in the direction of N. 45° E., or 25° eastward of the place where I first saw it. I concluded that the direction of its path was probably from W. by S. to E. by N. It was obviously going from me; its path making an angle with the optic axis of about 60°.

13. Not less than eight minutes, nor more than ten, after the disappearance of the meteor, there was a report very loud and heavy, accompanied with a very sensible jar. Though mistaken for thunder by those who did not see the meteor, it did not much resemble either thunder or the report of a cannon; but was louder, shorter and sharper than either, and was followed by no perceptible echo.

14. A friend of mine, who was in Berlin at the time, about 23 miles due N. of New Haven, saw the meteor distinctly, but made no particular observations concerning it. His estimate of it accorded generally with mine, but it appeared to him larger, more elevated and somewhat more to the East in its apparent place.—I could not learn that the fragments which fell from it were discovered.

I am most respectfully
Your obedient servant,
S. E. DWIGHT.

Art. VI.—*Miscellaneous Observations on the coal, diluvial and other strata of certain portions of the state of Ohio—contained in a letter to the Editor; dated at Marietta, June 7, 1827, from* Dr. S. P. Hildreth.

In my journey this spring I visited the Ohio canal at Newark, Licking Co. and made some observations on the different formations over which I travelled.

The road from Marietta to Zanesville, for the first twenty miles, passes up the Muskingum bottoms, which are strictly alluvial. After leaving the river, it passes over hills of a moderate height, which are diluvial—abounding in quarries of limestone, sandstone and bituminous coal. The coal generally lies under the sandstone, and sometimes, in a thin stratum above it. The layers are of various thickness, from a few inches to six feet. So far as I have observed, there appears to be a bed of limestone, underlying all the hills, and the sandstone through the whole region of the country, from Marietta to Zanesville. It is laid bare by the wash of the rivers and creeks, and all the ripples and falls, are made by this bed of limestone.—In this neighborhood, it is very compact and free generally from petrified shells. The deposit on this limestone, appears to have been sand, now forming sandstone; above this, is a red imperfect stone like slate or soapstone, of various colours, and abounding with iron—then red argillaceous earth, originally from ten to twenty feet in thickness, but now of various thickness, as washed away by the rains and streams, in forming the surface of the earth into its present broken aspect, but easily traced in ascending and descending the hills; above this a deposit of ash colored earth, also argillaceous, from two to six feet in thickness, *very fine* and pulverulent; and on this, vegetable mould of various thickness, according to the position and exposure of the under stratum, thicker on the north and thinner on the south sides of the hills; occasionally on, or near the tops of the hills are thin beds of limestone; these seem of more recent origin, and sometimes contain shells. The stratum of red earth disappears, about thirty miles this side of Zanesville, and its place is occupied by a yellow loam very friable, and easily worn down by rains or running water—but the stratum of ash coloured earth on the top still continues. The rock formation is much the same in the neighborhood of

Zanesville; coal is more abundant, and from the bed of the Muskingum to the tops of the hills, three strata are found at different elevations, some above the sandstone and some below. The falls at Zanesville, which afford such fine mill seats, are made by the deep or lowest bed of limestone; the sandstone is some of it very fine, and variously colored with iron, resembling variegated marble. I saw some near Licking creek, fifteen miles from Zanesville, quarried for the canal locks, of a deep red. I crossed the river at Zanesville and travelled on the north side of Licking creek to Newark twenty-five miles; the country is hilly, and of the same formation as about Zanesville. At Newark the hills cease, and there is a gently rolling country to Delaware; from near there to the Lake Erie, the country is generally flat. From Newark I travelled twenty miles in the direction of Delaware. Through all this space the formation is diluvial, being a yellowish loam, of from twenty to fifty feet in thickness based on a stratum of tough blue clay from three to six feet in thickness. In digging for wells they pass through this yellowish earth, to a greater or less depth, as the land is more or less elevated, and find permanent water as soon as they pass the blue clay, and not before. But the most singular feature of all is the adundance of detached fragments and blocks of primitive rocks, with which this region is filled. All are rounded or worn by attrition, and lie in that confused state which they might be supposed to exhibit, if brought there by an immense current of water. I picked up pieces of granite, hornblende, greenstone, gneiss, quartz, limestone, &c.; some blocks of granite are large enough to make a pair of mill stones and are used for this purpose. After leaving the hills, very few quarries, or stones in place are found, except limestone all the distance to Lake Erie. Above the diluvial deposit is a bed of vegetable earth, very rich, supporting a heavy growth of timber and making excellent farming land. In reflecting on this formation, the impression is irresistible that it is the result of an immense current or body of water pouring down from the north, sweeping the south side of Lake Erie, and all the Scioto country and Miami valley, as those regions are said to furnish specimens of the same primitive kind.

In my return I passed over "Flint Ridge," so called; it is the dividing ridge between the waters of Licking and Jonathan's creek. It commences five miles south-east of

Newark and extends down the creek seven or eight miles. The surface of the earth is covered with quartz rock to the depth of six or eight feet, and abounds in beautiful rose colored and limpid crystals. It is full of excavations, made by the aborigines in search of flints for arrow heads. At the east end of the ridge, twelve miles from Zanesville, fine mill stones are made of cellular quartz, equal to, or better than French Burr.

Art. VII.—*Intelligence and remarks respecting* High Pressure Steam Engines, *from the Franklin Journal for June, 1827.*

1. High Pressure Safety Steam Engine *of Mr. Perkins. Letter from Jacob Perkins, Esq. to Dr. Thomas P. Jones, Editor of the Franklin Journal.**

London, March 8, 1827.

My Dear Friend,—You must attribute my not having written to you at an earlier date, not to want of inclination, but to a desire of being able to communicate the information which I now give you, namely, that my most sanguine expectations are realized, and to the utmost, in the completion of my *high pressure, safety engine.* This I should have been enabled to say, long since, had it not been for the opposition which I have encountered from the avaricious, and interested individuals, by whom my course has been retarded, much more than it has been by mechanical difficulties, although these have been enough, in all conscience.

Many of my friends, and some of them very scientific men have expressed great fears, that I had attempted impossibilities; and were of opinion that steam engines were so well understood, as to leave little that is new, on this subject, to be discovered. I will ask you, and I will allow no one to be a better judge, if it is not new to generate steam of all elasticities, from the minimum to the maximum, without the least danger? If it is not new, in the generation of steam, to substitute *pressure,* for *surface,* which I consider the basis

* The high interest and importance of these communications induce us to give them entire.—*Ed. Am. Jour.*

of my invention? If it is not new, to have a pressure of 1000 lbs. to the square inch, on one side of the piston, while on the other side of it, all resistance is taken away by a vacuum, and this produced, without an air pump, or any more water than is used in generating the steam? If it is not new to have invented a metallic piston, which requires no lubrication, and yet is as tight as the piston of an air pump? If it is not new to have applied Sir Humphrey Davy's zinc protectors to steam cylinders, to prevent oxidation? This, I found, took place in my cylinders, when the engine was not at work, after I found that I could dispense with oil. If it is not new to dispense with the *eduction valve*, and *eduction pipe*, having no other than a small induction valve, and that, so constructed, as to neutralize the pressure, requiring no oil, and very little power to open, and to close it? If it is not new, to allow steam to escape at an opening, 250 times larger than the steam pipe? All this has been effected as our friend Lukens can avouch, he having witnessed all these facts, as well as myself. And lastly, if it is not new, to have discovered, that steam may be generated, although in contact with the water, at all temperatures, without producing corresponding elasticity?

As soon as my last patent is specified here, I will forward it to you, together with the drawings, not only for your inspection, but with a request, that you will forward them to Washington, as a petition to obtain a patent, will accompany them.

I herewith send you a paper, "On the Explosion of Steam Boilers, &c." This paper I have not yet published here, as it might lead to the discovery of my method of correcting the evil arising from generating surcharged steam, before my patent is specified; but as this will be secure, in a very short time, you are requested, if you approve it, to publish the paper in your interesting Journal, as I am anxious for its early appearance in my own country. I have, in confidence given a copy to Dr. Wollaston, to Mr. Faraday, and to several engineers, whom I could trust, and who all agree that it assigns the true cause of explosions. I long to see, and to converse with you, and my other really scientific friends in the United States, on this and other interesting points, connected with my engine.

I have had much interested opposition to contend with, since my residence here; but some of the best men in the country have constantly stood by me, or I must have sunk under the pressure. This government have now given the stamp business, to Perkins and Heath, which we should long since have had, and the country thereby have been saved thousands, but for the intrigues of an individual who is now *sent to Coventry.*

More than a dozen projectors have attempted to make tubular boilers, since I commenced my experiments, of generating steam by small quantities of water, *under pressure;* but for want of pressure, (which is the novelty I claim in my patent,) they have all failed. M'Curdy from New York, who brought out Hawkins' project was the first who opposed me. He stated that I had stolen Hawkins' invention, and gave an air of probability to his assertion, by producing such evidence from the United States as he hoped would substantiate it. Yet he was altogether ignorant of my method of generating high steam; and indeed there are not, at this day ten persons in the world who are wholly acquainted with it. M'Curdy took out a patent in this country, and sold it to the amount of ten thousand pounds; reserving one-third to himself. He has made three small steam boats; one large enough to take passengers to Richmond, but no one of them ever steamed more than three miles an hour. The quantity of coal consumed I could not learn; it must however have been too great to answer, had there been no other objection, and they have all been abandoned. Of all the methods yet contrived to generate steam, this was the worst. Had the agent in this business, been considered as the representative of the mechanical talents of his country, it would have been most unfortunate; but such is not the case, as there are now here, four Americans, who stand confessedly pre-eminent, viz. Mr. Lukens of Philadelphia, Mr. Wright of New York, Dr. Church, and Mr. Dyer of Boston.

Brown's vacuum engine, has at length given over, although its death was a very hard one. It was at last found, that although at the beginning of the stroke, the mercury showed a vacuum equal to twenty inches, yet his rarified air became, towards the end of the stroke, more dense than the atmosphere, and there was, consequently a great loss from its reaction. I had frequently predicted, that this would be the case and am apprehensive that Morey's explosive engine will be unavailable, from the same cause.

Brown has certainly shown great ingenuity in the variety of mechanical contrivances which he has invented, in order to overcome the difficulties with which he had to contend; his engine was a beautiful piece of mechanism; its appearance was such as caused it to operate like a charm on his numerous visiters, and many were consequently, induced to take an interest in, and expend large sums of money, to perfect an instrument from which they calculated to derive large profits. Is it not astonishing, that men of intelligence should not quickly perceive the difference, between condensible steam, and incondensible air? I have already remarked that at the beginning of the stroke, the barometer indicated a high degree of exhaustion; it sometimes rose to twenty-four inches, yet his piston, if made to approach the end of his cylinder, as closely as in a well made steam engine, could not, from the density of the contained air, pass the dead point. His first engine, you know, raised water ten or twelve feet high, and this was employed to drive a water wheel; in this arrangement, he did not discover how soon his rarified air lost its power; but when he endeavored to make his engine work with a piston, he began to experience this unanticipated difficulty. By a very clever contrivance, he, *apparently*, overcame this obstruction, but not without great waste of gas. He attached to his engine, a large separate condenser, in which he burnt his gas, professedly, for the greater convenience of condensation; but it was, in effect, nothing more than lengthening his cylinder, which would have produced the same result in a way much more simple; but to have had a ten foot cylinder, with one foot stroke, would at once have torn off the mask, by which the true features of the contrivance were concealed; a catastrophe, which the inventor, very naturally endeavored, as long as possible to avoid. The consumption of gas was enormous; but as he made his own or drew it directly from the city pipes, no one but himself could tell how much he used.

Fascinated with the beauty of the machine, there are many who yet declare it to be no failure, and that Brown has been used very ill by the *Gas-engine Company.* One gentleman, who had lost much money in this concern, called on me the other day, and expressed great regret that the gas-engine had not been in my hands; I told him that this would have produced but one advantage, that of having lost less money by the concern, as it was not from want of mechanical skill, that Brown did not succeed, but because the laws of nature were against him; that I was pursuing experiments in accordance with those laws; and that in this consisted the difference in the results to be anticipated from his labours, and from mine. This gentleman expressed much surprise when I explained to him the difference between condensible steam, and incondensible air.

I am now engaged in building steam artillery, as well as musketry, for the French government. The English government would certainly have adopted this invention, had it not been for the gratuitous and false statements of certain engineers, who declared, that although I was able to make a great display at the public exhibition, made by order of government, yet it was delusive; and that I had never made a generator which stood for a week, and that I could not keep up the steam for more than two or three minutes at one time. These statements obtained credit, the more readily, as any improvement in the art of war, which could be adopted by other powers, and which would have a tendency to place the weak upon a par with the strong, appeared likely to benefit other countries more than England.

The French government have determined to give our new system a fair trial. A series of experiments have been made at Greenwich, which were attended by the French engineers appointed for that purpose, by the duke d'Angouleme, together with one of his aids, and prince Polignac. Their report was so satisfactory to the French government, that a contract was immediately made. An English Engineer of the first class, and one who is very much employed by this government, has joined me in the guarantee of the four points which some of the English engineers have doubted; namely, the perfect safety of the generator, its indestructibility, the ability to keep the steam up, at any required temperature, for any length of time, and its great economy.

The piece of ordinance is to throw sixty balls, of four pounds each, in a minute, with the correctness of the rifled musket, and to a proportionate distance. A musket is also attached to the same generator, for throwing a stream of lead from the bastion of a fort, and is made so far portable as to be capable of being moved from one bastion to another. This musket is to throw from one hundred to one thousand bullets per minute, as occasion may require, and that for any given length of time. It was an observation made in my hearing, by his grace, the duke of Wellington, that any country defended by this kind of artillery, would never be invaded, and I am very confidently of this opinion.

As soon as this machine is completed, it is to be exhibited to this government, and to several engineers from other powers, who are over here for that purpose. I have no fears for the result, neither has Mr. Lukens, since he witnessed the experiment made for the French government. He saw the steam gun discharge at the rate of from 500 to 1000 balls per minute, and the steam blowing off at the escape valve, during the whole time; he is equally confident with myself, that the steam may be kept up in such a manner as to discharge a constant stream of balls during the whole day, if required. As regards economy, I am within the truth, when I say, that if the discharges are rapid, one pound of coals will throw as many balls as four pounds of powder.

It has been stated as an objection to the steam gun, that it would take too long to get up the steam, in case of an attack. To this I answer, that a very small quantity of fire will keep the generators sufficiently heated, when there is no water in them: and that when there is any chance of their being suddenly wanted, they should be kept heated in this way. The heat of the generators would last long enough to give off steam; until the fire is sufficiently increased to furnish a constant supply. For naval purposes this cannot be an objection, as the steam must always be up. Lord Exmouth, after witnessing a few showers of lead observed, that he believed the time would come, when a steam gun boat with two steam guns in her bow, would conquer any line of battle ship; and Sir George Cockburn said, that the mischief of it was, it would be to nations what the pistol was to duellists, it would bring all, whether strong or weak, upon a par.

To prove the safety of my engine, I have worked it under a pressure of 1400 lbs. to the square inch, or at a hundred atmospheres, and cut off the steam at one twelfth of the stroke; this was merely to manifest what could be done with perfect security. My usual pressure is 800 lbs. per inch cutting off at one-eighth, and letting the steam expand to below 100 lbs. per inch. I let off at the dead point, at one flash; the manner of doing this I long to explain to you, but must first get my last patent sealed.

I am informed that our friend, Dr. Hare, thinks I have ventured beyond my depth; in this he is not singular, nor do I wonder that such an idea should prevail, after the publication of so many absurd things respecting my engine; I had no knowledge of these publications, and of course had no controul over them. Indeed I have been extremely cautious about publishing any thing myself, or sanctioning it in others; my determination having been first to complete the *essential* improvements of which I have been in pursuit. I presume that you have seen my last paper on the compression of water, air, &c. Its publication by the Royal Society, has created no small sensation among the philosophers of the old school. The council would not have allowed the reading of it, had not Dr. Wollaston and Sir Humphrey Davy witnessed many of the experiments. I shall soon publish an experiment with which I think Dr. Hare will be pleased, as it will, if I mistake not, prove practically, what the doctor has so ably attempted to establish theoretically, namely, that caloric is matter. The proof is simple and direct, and I am persuaded that when you see it, you will think it conclusive. I was led to the discovery of this fact by my experiments upon steam; the results of many of which have been very extraordinary, and quite unexpected. One of the most striking, is the great repellent power of heat. I discovered that a generator, at a certain temperature, although it had a small crack in it, would not emit either water, or steam. This fact I mentioned to a very scientific friend, who questioned its accuracy, and to convince him, I tried the experiment; but he concluded that the expansion of the metal must have closed the fissure. To remove every doubt, I proposed to drill a small hole through the side of the generator, which was accordingly done. After getting the steam up to a proper temperature, I took out the plug, and although we were working the engine at thirty atmospheres, nothing was seen, or heard to issue from the plug hole; all was perfectly quiet; I next lowered the temperature by shutting the damper, and opening the furnace door; a singing from the aperture was soon observable, and when a coal was held before it, rapid combustion ensued; nothing however was yet visible, but as the temperature decreased, the steam became more and more visible, the noise at the same time increasing, until finally the roar was tremendous, and might have been heard at the distance of half a mile. This was conclusive. I should mention that, at the aperture, the iron was red hot.

My belief is that water cannot be brought into contact with iron heated to about 1200°, without a force equal to the maximum pressure of steam, which is equal to about 4000 atmospheres, when the water is heated to about 1200°. That pressure would, I believe, keep it in contact with iron at any degree of heat, and the steam would then be as dense as water. It is very evident that if it would require that force to keep the water in contact, heated as it was at the vent hole, thirty atmospheres must be insufficient to effect this: but the experiment affords some data towards answering the question, at what distance from the heated metal the water remained, when under the pressure of thirty atmospheres? We may safely aver, that it exceeded one-eighth of an inch, as the hole was one quarter of an inch in diameter.

After commencing this letter, I ascertained that my patent was likely in a few days to pass the great seal, and have delayed forwarding it until I could give you some account of the effect upon the minds of those engineers who were open to conviction, of an experiment performed before them. The patent has been sealed, and the engine has had its power and economy tested. The result has been so satisfactory, that an engineer, who employs at least three hundred hands, has taken orders to make engines, (for I license them out,) with the following guarantee, viz. that of saving half the fuel, and three-fourths of the weight and bulk, with less liability of derangement than ordinary engines. The engineer whose name is Penn, and who is frequently employed by government, is now making an engine for steam navigation, with a *nine* inch cylinder, and *twenty* inch stroke; he joins me in guaranteeing it to be of sixty horse power. It will not occupy more than *one-sixth* of the room, nor exceed *one-sixth* of the weight, of the ordinary Boulton and Watt's engine, of the same power.

I have sent you the last "London Journal of Arts, &c." which contains some account of my engine, which is nearly correct as far as it goes. It should however have stated, that the piston was eight inches in diameter, that it was a twenty inch single stroke engine, a good seventy horse power and consuming but one-fourth of the coal of a condensing engine. The weight on the end of the lever was three hundred, instead of one hundred and fifty pounds.

You may, my dear sir, depend upon what I have written; it is the result of actual experiment, and there is no fallacy in it. Having succeeded in making a piston which requires no oil, I am determined to ascertain the limits to which pressure can be carried. I am now making a small engine, strong enough to bear 2000 lbs. per inch, and when done you shall know the result. Nothing but the piston will limit the power.

The victory which I have obtained, has been a glorious one for me. For the last three months, many of the engineers had declared me insane, as I had asserted that I could condense, and produce a vacuum under the piston, without either an air pump or condensing water; but the tables are now turned, and my triumph over those who have illiberally assailed me, is complete. By the next packet you may expect drawings, &c. of my engine; and I hope within one short year to take a seat, with my friend Dr. Jones, by the side of a generator, sustaining a pressure of 3000 lbs. to the square inch; for this pressure on the generator is required to produce a working power of 2000 lbs. to the square inch upon the piston.

I have several times mentioned the name of our friend Lukens, who is here, and in pretty good health. He has been introduced to many of the first characters, and is considered as very clever, particularly by one of the greatest philosophers, and best judges of the age. His fame is already high, and is rising, but it must of course require a residence here of some time, for him to be estimated, and remunerated, according to his merits.

This letter has been written, a few lines at a time, as I could catch a spare moment, and sometimes at intervals of several days. You likewise know, that the business of writing is one in which I do not profess to be at home; you will, therefore, I am sure, excuse any inaccuracy, or want of connexion, which it may exhibit, and believe me to be,

Yours, truly, JACOB PERKINS.

2. *Observations on Perkins Improved Steam Engine. By the Editor of the London Journal of Arts, &c.*

This important invention, respecting which, such conflicting opinions have been long entertained, appears to be now assuming a shape that will very shortly determine the points of controversy, (viz.) the question of the perfect safety of the engine; its actual power; and the great economy of fuel.

Mr. Perkins last patent has passed the Great Seal; his recent improvements may, therefore, with safety now be mentioned. The mechanical difficulties against which he has had to contend, in controlling and applying the tremendous power of high pressure steam, have not only absorbed much more time than he anticipated, but have also demanded a greater outlay of money.

The newly constructed engine, to which we have adverted in our preceding number, has been at work for some days, apparently very much to the satisfaction of the few engineers who have seen it. We have been repeatedly present during its performance, and studiously considered its operations, in which we have not been able to detect any fallacy. As, however, we do not mean, at present, to pledge ourselves as to any definite power which the engine is capable of exerting, we shall simply state the manner in which a certain power has been demonstrated in our presence, leaving our readers to draw their own conclusions, from the facts set forth.

The fly-wheel is eight feet in diameter, and the steam, working, as we are informed, at a pressure of twenty-seven atmospheres, caused the piston to perform sixty strokes per minute. The periphery of the fly-wheel being pressed upon by a loaded lever, (called in mechanics,) of the *second order.* The power exerted by the engine at that time, may be known by calculating the amount of force, or friction, acting upon the fly-wheel.

The lever was a wooden bar, about four inches square, bearing upon the periphery of the wheel at the top. The shorter arm of the lever, or distance from the fulcrum to the impinging point, where the pressure acted upon the wheel, was fourteen inches; from thence to the end, that is, the longer arm of the lever was ninety inches. To the extremity of the lever was suspended a weight, making with that of the bar, rather more than one hundred and fifty pounds. From this may be known the actual force overcome, or work done by the engine at that time. By the addition of fifty pounds weight to the end of the lever, the engine labored, but still worked steadily; by the removal of part of the weight, the speed of the engine became nearly doubled.

The steam, it was said, acted under a pressure of twenty-seven atmospheres, but Mr. P. states that he usually employs a pressure of fifty-six atmospheres, and that the consumption of coal per hour, is about half a bushel.

Under this pressure of about 800 lbs. upon the inch, the steam is admitted into the working cylinder, and when the piston has descended through one-eighth of its stroke, the ingress of steam is shut off and the other seven-eighths of the stroke is performed by expansion.

Mr. Perkins' original idea of substituting pressure for surface, in generating steam, (which appears to be the basis of his invention,) has never for a moment been abandoned; and the invention, if satisfactorily established, must certainly be considered as of the utmost importance, particularly in its first feature, *absolute safety*, which could hardly have been contemplated in any other plan of boiler, to the extent which this construction evidently exhibits the capability of effecting. From the mode of constructing the compound generator as now adopted, it becomes a safety valve of itself; for the pressure is divided into so many compartments, that any one of them may explode with impunity, without even disturbing a brick of the furnace. Although in the early part of the invention, many explosions took place, without any attending accident, (which served to show the safety of this method of generating steam, as well as to point out the proper way of constructing the generators,) yet for the last two years, it is said that nothing of the kind has taken place, notwithstanding the steam has been frequently raised to a pressure of above 1500 lbs. to the square inch.

To illustrate the safety of this method of generating steam, let us imagine a few tons of gunpowder to be confined within one compartment, and if ignited, the tremendous effect will be readily anticipated; but let this same quantity of powder be divided into a proper number of compartments, and any one coversant with fire works, would not hesitate to explode it with a match, of not more than a few inches in length. We should not have dwelt so long on this part of the invention, had not the alarm, from the great number of explosions within the last year or two, not only in this country, but in France and America, created universal terror; particularly in steam boat travelling; and the danger of explosion would still be more alarming, since it has been recently discovered that the safety valve is of no use, when an explosion takes place from the sudden generation of steam.

We will now mention some of the practical difficulties which Mr. P. has had to contend with. First, the re-action of this highly elastic steam on the eduction side of the piston, occasioned by its density, and expansive property.

Second, by the increased friction occasioned by the great pressure on the valves. Third, the carbonization of the lubricating material, whether tallow, oil, or other fat, which was used for the piston and valves. Fourth, the difficulty of preventing the steam from becoming surcharged with caloric, which at times, would be at such an excess, as to melt the joint packings, and heat the steam pipe red hot.

The first mentioned difficulty is removed by a very novel method, by which the eduction pipe and valve are dispensed with. At the end of the stroke, the metallic piston enters an enlargement at that part of the cylinder, and passes three-quarters of an inch below it, leaving sufficient space for the steam to flash out at the dead point, into a tube leading to the chimney, at which instant the vacuum valve [?] closes, and shuts off seven-eighths of the steam, which escapes up the chimney, and the other eighth, under the piston, is easily condensed by a spray of water, which is afterward used for generating steam. At the next puff, the condensed steam, water, and air, are thrown out, and the heated water runs into the cistern of the pump, from whence it is forced into the generator, dispensing with the complicated and expensive air pump, as well as with condensing water.

The second difficulty is removed by rendering the employment of an eduction valve unnecessary; for the induction valve requires to be only one thousandth part of the area of the cylinder; the power required therefore to lift it, (even if the valve was not so constructed as to neutralize the pressure,) would be very little.

The third difficulty, which was a very serious one, when the temperature of the steam employed was five hundred pounds upon the inch, is removed by using a metallic piston, made of a peculiar alloy, requiring no lubrication whatever, since it glazes by its working. And as for valves, there is only one little, simple, lifting induction valve, and that, being destitute of friction, requires, of course no oil.

Fourth, preventing the steam from becoming surcharged with caloric. This important part of Mr. P's. invention, we, for certain reasons, are restrained from explaining at present; it is however, accomplished, and will be made known when the specification of the last patent is enrolled.

We understand that Mr. P. has taken some orders for his high pressure, safety engines, and guarantees the saving of half the fuel commonly used, for a given power, the weight not to exceed one third of ordinary condensing engines, and not to occupy more than one-third the space; with absolute security from the dangerous effects of explosion.

3. *On the explosion of Steam Boilers; by* Jacob Perkins, Esq.

It has been generally considered a well established fact, that the caloric of steam, at a given elasticity, is invariably the same, when in contact with water; but this is far from being the case. It may be and often is, so generated as to indicate very high degrees of temperature without a corresponding increase of power; so as evidently to prove, that temperature alone, cannot be relied on as a measure of the elastic power of steam. Many experimentalists have thus undoubtedly been led into error, especially in reference to high temperatures. If any part of the boiler which contains the steam be suffered to become of a higher temperature than the water contained in it, from want of a sufficient supply, the steam will readily receive an excess of caloric, and become surcharged with it, without acquiring proportional elasticity. In some recent experiments, I have heated steam to a temperature, that would have given all the power that the highest steam is capable of exerting, which would have been 56,000 pounds to the square inch, if it had had its full quantum of water; yet the indicator showed a pressure of less than five atmospheres. Having satisfied myself, by repeated experiments, as to the certainty of this curious fact, the thought struck me, that if heated water were suddenly injected into the superheated steam, the effect would instantly be, the formation of highly elastic steam; the strength of which would depend upon the temperature, and quantity of the surcharged steam, and of the water injected. To ascertain the truth of this theory, I made the following experiments.

A generator was filled with water, and heated to about 500 degrees, and consequently, exerted a force of about 50 atmospheres; but the pressure valve being loaded to about 60 atmospheres, it prevented the water from expanding into steam. The receiver, which was destitute of both water and steam was heated to about 1200 degrees; a small quantity of water was injected into the generator, by the forcing pump which forced out, from under the pressure valve, into the receiver, a corresponding quantity of heated water, and this instantly flashed into steam; which from its having ignited the hemp cord, that covered the steam-pipe, ten feet from the generator, must have been at a temperature of at least, 8000 degrees, which would be equal to about 800 atmospheres; but, from want of water to give it its necessary density, the indicator showed a pressure of about five atmospheres. Whether the pressure of the steam, which was rushing through the steam-pipe, was at 5 or 100, or more atmospheres, the steam-pipe kept at the high temperature before mentioned; which I attributed to the steam being surcharged whith caloric. The pump was now made to inject a much larger quantity of heated water, and the indicator showed a pressure of from 50 to 80 atmospheres; the throttle valve being partly opened, it soon expanded, to the former pressure of about 5 atmospheres. The water was then injected again and again, and the indicator was observed to oscillate at each stroke of the pump, from 5 to between 40, and 100 atmospheres, according to the quantity of water injected; clearly showing that at this reduced pressure, there was a grêat redundancy of heat, with little elastic force. It soon occurred to me, that to this might be traced the true cause of the tremendous explosions, that suddenly take place, in low, as well as in high pressure boilers.

There are many instances, where, immediately before one of these terrific explosions had taken place, the engine labored; showing evidently a decrease of power in the engine. To illustrate the theory of sudden explosions, let us suppose the feed pipe, or pump, to be choked; in this case, the water would soon sink below some parts of the boiler, which should be constantly covered by it, thus causing them to become heated to a much higher temperature than the water. The steam now being in contact with the heated metal, readily takes up the heat, and becomes surcharged with it.* Since

* Practical engineers have frequently witnessed the destruction of the packing of pistons, by their becoming charred, although the steam issuing was in contact with the water, the temperature of which did not exceed 230 degrees. It is very evident, that this steam was surcharged with heat, and was much above the temperature of the water upon which it was reposing, and in a suitable state to produce explosion, had the water been allowed to rise with the steam, by drawing it off faster than it was generated.

caloric will not *descend* in water, it cannot be taken up by the water which is below it. The steam thus surcharged, will heat the upper surface of the boiler, in some cases *red hot*,* and will ignite coals, or any other combustible matter which may be in contact with it. If the water which is kept below the surcharged steam, by the pressure of it, should, by any circumstance, be made to take up the excess of caloric in the steam, as well as that from the upper part of the boiler, which has become heated above the temperature of the water, in consequence of the water having been allowed to get too low, it will instantly become highly elastic steam, and an explosion cannot be prevented by any safety valve hitherto used. To show how the water may be suddenly brought in contact with the over-heated parts of the boiler, as well as the surcharged steam, it will be necessary to state the following facts.

As long as water is not heated above 212 degrees, it will simply boil, and give off atmospheric steam, without the water having any tendency to rise with it; but as it becomes more and more elevated in temperature, its disposition to rise with the steam becomes more and more apparent. As the steam presses on the surface of the water, in the same ratio as the water increases in temperature, it only boils without rising, as when at atmospheric pressure; but if the steam should be drawn off faster than it is generated, this

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* Mr. Moyle, a practical engineer from Cornwall, gave me the following interesting fact:

On going into his boiler room, he observed a ladder, the foot of which rested on the top of his boiler, to be in flames; he instantly ascertained that the top of the boiler, from some cause which he was then unable to determine, had become *red hot;* with all possible promptitude he ordered the fire to be quenched, which probably saved his premises and perhaps his life. Mr. Moyle found, upon examining the boiler when cold, that very little water remained in it.

A stronger case still, was that of an explosion at the iron foundry at Pittsburg, North America. As is the practice in North America, a high pressure engine, of sixty or eighty horse power, was supplied with steam from three separate cylindrical boilers, each being thirty inches diameter, and eighteen feet long. One of these boilers had for some time been observed to be getting red hot; but, as the other two supplied a sufficiency of steam for the work then doing, it was disregarded, until it exploded. The main body of the boiler separated from one of its ends, at an angle of 45 degrees, and passed off like a rocket through the roof of the building, and landed about 600 feet from it.

artificial pressure would be taken off, and the water would rise with the steam in proportion to the suddenness and rapidity of its escape. The water and steam in this mixed state, thus filling every part of the boiler, the excess of caloric in the surcharged steam, as well as the extra heat from the boiler, will be instantly taken up by the water which rises with the steam, by which means the steam becomes sufficiently dense (or powerful) to produce the fatal effects too often experienced, not only from high, but from low pressure boilers. If for instance, the water (as has before been noticed,) should be suffered to get below any part of the boiler, which is exposed to the fire, the steam will soon become surcharged with heat. If a boiler, thus circumstanced, should have the weight taken from the safety valve,* or a small rent be effected in the boiler from its giving way by the pressure of the steam, an explosion will be sure to follow. A remedy for this kind of explosion, which appears to be the only serious one, is that of not allowing the water

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* It was stated in evidence at the coroner's inquest taken at the Humber, in the case of an explosion on board of the Graham steam boat, that just before the explosion took place, twenty pounds were taken off the safety valve. Now, if the steam in this boiler had been properly generated, the relief given to the safety valve, could not have produced explosion; but if the water had got low in the boiler, (as was probably the case,) and the steam surcharged with heat, the ready way to produce explosion, was to allow the steam to escape faster than it was generating, when kept in the lower part of the boiler by the pressure of the confined steam.

Several instances have occurred when there has been sufficient warning, by the rushing of the steam from a rent or fracture, for the bystanders to escape from injury before the explosion took place. There has been, at least, one case, where tho boiler was raised from its bed, into the air, by the force of the steam issuing from the rent, (upon the principle of the rocket,) before the water had sufficiently expanded by the removal of the steam, caused by the rent or fracture, to take up the heat of the boiler, and the surcharged steam; when an explosion took place after the boiler had been raised many feet in the atmosphere, and it separated with a very great report, one part rising still higher, while the other was dashed with great force on the ground. It is, I believe, a fact, that more persons have been killed by *low*, than by high pressure boilers.

It is but about twelve months, since sixteen persons were killed by the bursting of a low pressure boiler, in Flintshire. High pressure boilers have since been substituted. Some of the most dreadful accidents from explosions which have taken place in America, have occurred from low pressure boilers.

to subside below any part of the boiler which is exposed to the fire. In case the water should settle, it may be known by having a tube, with its upper end trumpet-mouthed, and its lower end fixed in the boiler, entering a few inches below the surface of the water; then as soon as it subsides sufficiently to allow the steam to blow off, the blast will give warning that no time should be lost in supplying the water or checking the fire.* When highly surcharged steam is rushing from the safety valve, or any other aperture, it may be known by its perfect invisibility, even in the coldest day, nor can it be seen at any distance from the valve or cock; it is however, condensible; as may be seen by holding any cold substance in its range.

4. *Facts and Observations, on the bursting of the boilers of Steam Engines. By* Erskine Hazard, Esq., *Civil Engineer.*†

The frequency of disasters arising from the bursting of boilers, in steam boats, both with high, and low pressure engines, makes it the imperious duty of all those who have given particular attention to the subject, to make public any ideas which may throw light on the cause of them, as they may thereby aid in preventing repetition. With this view, I take the liberty of sending you the following explanation, which was given to me by our countryman Perkins. He builds his theory, on the ground that the power of steam does not depend upon *temperature* alone, but principally upon the *quantity* of *water* that is contained in a given bulk of it; in other words that its power is derived from its *compression.* This corresponds with the experience of the late Col. Alexander An-

* This will apply only to low pressure boilers, on account of the height of the column which would be required to balance the pressure of the steam. The high pressure engine as used in Cornwall, would require a column, varying from 60 to 120 feet; and the new high pressure safety engine, now coming before the public, would require a column more than four times as high as St. Paul's cross, to balance the steam.

† This communication from Mr. Hazard, was received a month earlier, than that from Mr. Perkins, although too late for insertion in our number for May. The facts and reasoning which it contains, are intended to enforce, and confirm, the theory offered by Mr. Perkins; we, however, do not apprehend that our readers will object to some repetition, on a subject so truly of *vital* importance.—*Ed. Franklin Journal.*

derson, who gave me the same theory many years since, and at the same time informed me, that when distilling by steam, he uniformly found *the quantity of liquor* produced in a given time, to be in exact proportion to the *pressure within* his still. He hence concluded, that atmospheric steam, confined in any vessel, in such a manner that it could not get an additional supply of water, might be *heated red hot*, without bursting the vessel, or increasing its power. Perkins states, that he has completely realized this idea, in his experiments. He also mentions a fact communicated to him by Mr. Williams, principal manager of the Dublin and Liverpool steam company which was this. The people on board the boat were alarmed, while on their voyage, by the smell of *pine* smoke, and concluded that the boat must be on fire; but upon searching, they found a piece of pine wood on the top of one of the boilers, which was nearly burnt to a coal; it was in such a situation, that no fire could have communicated with it, except through the top of the boiler. The engine at the time, was working with the steam only a few pounds above the atmospheric pressure. Upon mentioning this circumstance to the captain of one of our Delaware steam boats, he informed me, that the leaden joints of his steam pipe were once melted, when the steam guage indicated only the pressure at which they usually worked. In both these cases, the water was so low in the boilers, that the heat was communicated to the steam through a portion of the boiler which had no water in contact with it, and which of course became red hot, while the steam could not part with its heat, *downwards*, to the water.

The *repellent power of heat*, is the proximate cause of explosion, according to Perkins' theory. This was one of the principle obstacles he met with in the progress of his experiments on high steam. In his tubular generators, he found it impossible to keep the water *in contact* with the metal, when a great heat was applied, until he adopted the expedient of the pressure valve, loaded with five atmospheres more than the pressure of the steam. The water was, as it were *wire-drawn*, or passed through the *centre* of the tubes in a fine thread, being repelled by the heat of the sides, which increased to redness, and finally destroyed the tubes. To show this repellent power of heat, he made a hole of one-fourth of an inch diameter in one of his generators, and adapted a plug to it, which was removed when that part of the tube became red hot; no steam or water escaped from it, notwithstanding the steam guage indicated a very high pressure; a wire was introduced into the hole to ascertain that it was free. The generator was then suffered to cool to a black heat, when the steam commenced issuing from the hole with great violence. Another experiment was to heat two cast iron bowls of equal dimensions, the one black, the other red hot, and then pour equal quantities of water into both: the cooler bowl uniformly evaporated the water first. I have frequently noticed very hot pieces of iron, when thrown into a blacksmith's slack trough, lie red hot for some time under the water, apparently surrounded by an atmosphere of heat, without throwing any steam to the surface. This will never be the case if the *tongs be plunged* into the water with the hot iron; as their heat, in some part, is only sufficient to raise steam, and not sufficient to prevent the water from coming in contact with them, and through them, with the whole mass successively. From the above facts, Perkins' explanation of the bursting of boilers, will, I think appear very plausible: it is this; that the water is suffered to get so low as to bring a portion of the boiler, not covered with water, in contact with the fire; this becomes red hot, and imparts its heat to the steam; the redness gradually extends itself below the water, which is at length repelled from the boiler, and thrown up among the *hot steam*, (like a pot suddenly boiling over,) which surcharged steam, immediately imparting its *excessive* heat to the water, forms steam of the greatest power and occasions the disastrous explosions.

In the late accident on board the Oliver Ellsworth, it seems to be impracticable to ascertain what was the state of the water in the boiler; but supposing it to have been at the proper height, may not the motion of the vessel, from a head sea, have left portions of the boiler exposed to the fire, for a length of time sufficient to make them red hot, and the above theory be thus rendered perfectly applicable? Should this be the fact, it appears to me an additional security would be obtained, by having the boiler divided by partitions, which though not tight enough to prevent a regular communication from the supply pump, and steam pipe, to every part of the boiler, would still be sufficiently so to prevent the water from rushing, in a body, from one extremity to the other, thus leaving portions of the boiler unprotected from the fire. These partitions might be constructed of rough boards in such a manner that they could be removed when the boiler required cleaning, and would rather favor, than retard the process of making steam.

The bursting of the boiler of the Ætna, was attributed to the supply pipe being choked. To this then the theory is perfectly applicable.

Your obedient servant,

ERSKINE HAZARD.

Philadelphia, April 16, 1827.

5. *On the Economy of using highly Elastic Steam Expansively; by* JACOB PERKINS, Esq.*

[See the Plate.]

The diagram, figs. 1 and 2, in the plate, will show the economy of using steam expansively, and also the method of compensating for the inequality of the pressure on the piston, which, if steam of 400lbs. to the square inch is used, and stopped off at the quarter stroke, will end its stroke at 100lbs. per inch. The diagram will also show that the velocity of the piston is continually varying, while the crank is uniform in its motion.†

From repeated experiments and much reflection, I am led to believe that there is great economy in using very high steam, and that expansively; that the higher you can practically use the steam the sooner you may cut it off. The diagram shows the gain in cutting off the steam at quarter stroke. Let the piston, which is represented by the line *k.* 1 *a.*, fig. 1, descend to *i. b.*, being one quarter of the stroke, with a constant pressure of 400lbs. per square inch. At this point, let the steam be cut off and expand to double its volume; when it arrives at *h. c.* it will be exerting a pressure of 200lbs. per inch, producing a mean of 300lbs. per inch, through the quarter stroke. Let the steam again expand to double its volume, and the piston will finish its stroke at *f. e.* at 100lbs. per inch, giving a mean of 150lbs. per inch for

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* The above article is subjoined to that on the Explosion of Boilers, in the pamphlet received from Mr. Perkins.—*Ed. Franklin Journal.*

† It is not pretended that this diagram is mathematically accurate; the object being merely to explain to the practical mechanic, in a sufficiently clear and concise manner, the principle of the advantage gained by using steam expansively.

each quarter, which add to the other two quarters, 400. 300. 150. 150. and the whole sum will be 1000,* giving an average pressure of 250 per square inch. It will be seen that, when the stroke is completed, the cylinder will be filled with steam at a pressure of 100lbs. per inch, which will be the same in quantity as though the steam had begun with a pressure of 100lbs. per inch, and continued all the stroke at that pressure. By using the same quantity of steam expansively, beginning at 400lbs., there is a gain of 150 per cent. If the steam is used at 600lbs. per inch, and cut off at one-eighth of the stroke, 225 per cent. will be the gain. To compensate for the unequal pressure of the steam on the piston, two cylinders should be used, particularly for steam boats and pumping, where the fly should be dispensed with. With the following arrangement, it will be seen, that while one of the pistons is at its greatest power, the other is acting with a diminished power.

The piston 1, fig. 1, in descending from *a* to *b*, moves in the same time through only half the space through which the crank moves, as will be seen by its path from 1 to 3. A force of 400lbs. is exerted on the square inch (that being the pressure of the steam,) in the first quarter of the stroke: at this point the steam is cut off leaving the other three-fourths of the stroke to act expansively. The piston 1, fig. 2, having completed half its stroke, when piston 1, fig. 1, begins its stroke, and consequently a compensation, near enough for all practical purposes, takes place.

It will be seen, that while the piston 1, fig. 1, has performed one-fourth of its stroke, that the piston 1, fig. 2. has moved from *c* to 6, performing seven-sixteenths of its stroke in the same time. The mean in each quarter, from *c* to *e*, fig. 2, being 150lbs., the amount of pressure to be added to the first quarter of the stroke of the piston, fig. 1, (which was 400lbs.) is 275lbs., producing an available power of 675lbs. at this part of the stroke. The piston, fig. 2, now moves but two-sixteenths of its stroke from 6 to *e*, and *f* to 8, while the crank moves through two of its divisions, from 6 to 8, which would, in another part of its path move (within a fraction,) with the same velocity as the piston. The

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* If the steam had continued the whole length of the stroke at 400lbs. per square inch, the sum would have been 1600lbs. consuming four times the steam with the addition of only 60 per cent to the power.

piston, fig. 2, in moving from 6 to *e*, gives a power of 25lbs., being the last of the expansion which ends at 100lbs. per inch. The piston, fig. 2, in moving from *f* to 8, being the beginning of the stroke, gives a power of 100lbs.; thus a power of 125lbs. will be acting on the piston 1, fig. 1, while moving from *b* to *d*, giving a power of 475lbs. to which add 125, will show a power of 600lbs. at this part of the stroke. The piston 1, fig. 1, now descends from *d* to *e*, being the last quarter of the stroke, giving 125lbs. of power to act with the piston 1, fig. 2, while moving from 8 to *h*, giving a power of 600lbs., add to this the 125lbs. and it will give a power of 725lbs. at this part of the stroke. The piston 1, fig. 1, now begins its stroke of 400lbs. per inch at *f*, and continues to *g*, with the same power, while piston 1, fig. 2, moves from *h* to 12 giving a power of 300lbs. to be added to the 400lbs., obtained at the first quarter of the stroke of the piston 1, fig. 1, at *f* and *g*, producing at this part of the stroke, 700lbs. of power. The piston 1, fig. 1, now moves from *g* to *i*, giving a power of 475, while the piston 1, fig. 2, moves from 12 to *k* and *a* to 2, giving a power of 125, which add to 475, gives a power of 600 at this part of the stroke. The piston 1, fig. 1, now moves from *i* to 1, being the last quarter of the stroke, giving a power of 125lbs., while the piston, fig. 2, moves from 2 to *c*, producing a power of 600; to which add 125lbs. will make 725lbs. at this part of the stroke.

By this arrangement, it will be seen, that a compensation is obtained, giving a more equable power than that which is produced by the single engine, whether high or low pressure, since it is well known, that at two points of the revolution of the crank, the power ceases, during at least one-twelfth of the time, which is the reason that so large a fly wheel is necessary. It is particularly applicable to steam boats, and may be used to great advantage in the double pump, as well as the balance-bob lifting pump, used in Cornwall for mining purposes, by the use of proper gearing. The present single stroke expansive engines, used in Cornwall for pumping, are preferred to all others, on account of their economy, although they are very limited as to the extent of the expansive principle, for want of compensation, as nearly the same power is wanted to finish the stroke of the pump, as to begin it.

The variation of the velocity of the piston, occasioned by the compound motion of the crank, and connecting rod, is not taken into view in this diagram. As the connecting rod is intended to be four diameters of the path of the crank, the variation will make no practical objection, being, at its greatest value, but one-thirty-second part of its range. If the engine should be worked by a connecting rod, as is sometimes the case in steam boats, say only one diameter of the path of the crank, the variation at each end of the stroke, would amount to a practical defect, since the piston would move with nearly three times the velocity at the lowest quarter of the stroke, that it would at the first quarter. Thus circumstanced, the crank must be above the cylinder.

As the law of expansion seems not yet to be settled, an arithmetical expansion has been used for this diagram, which, from its approximation to the real law, will be quite near enough for practical purposes. Many who are of the school of Tillock and Wolf, believe that the expansive power of steam depends upon heat only; while the Soho experiments are said to prove that elasticity depends simply on density, without regarding temperature, viz., that if a cubit foot of steam at atmospheric pressure, weighs one ounce, 50 atmospheres of steam would weigh 50 ounces; but Dalton, who is undoubtedly much nearer the true law, would make 50 atmospheres weigh but about 34 ounces.

I have no doubt that the nearer the atoms of water are made to approach each other, by compression, the greater will be the repulsive action of caloric, and that, in a more rapid ratio than has hitherto been allowed, especially in highly compressed steam. Its comparative density with the increase of power, diminishes faster than has been supposed even by Dalton.

6. *Perkins' Steam Engine.*

We have seen this engine repeatedly in action since our last notice of it, and to all appearance giving great satisfaction to those who have visited it; there has not, however, yet been exhibited any demonstration of the actual amount of power which it is capable of exerting, nor do we consider that its present situation, in Mr. Perkins' factory, is at all favorable to such an experiment. The public must, therefore, for the present, be satisfied with such inferencial proofs, of its capabilities, as may be drawn from a consideration of the amount of friction exerted upon the fly wheel, by the weighted lever described in our former report.

We have seen a testimonial given, for some private purpose, by several respectable engineers, whose names however, we do not feel ourselves at liberty to publish without authority. It was to this effect:

"We, the undersigned, having made ourselves practically acquainted with Perkins' high pressure safety steam engine, do not hesitate to state, that he has established the following new and important facts in the construction of his engine. 1st, Absolute safety. 2d, Greater economy in fuel than in any other engine hitherto invented. 3d, The removal of all the re-action of the steam, and atmospheric air, on the eduction side of the piston, without the necessity of an air pump. 4th, A new and simple flexible metallic piston, requiring no oil, or lubrication, whatever. 5th, A reduction of three fourths of the weight and bulk, by very much simplifying certain complicated parts of steam engines, and substituting a very simple eduction valve, for the one commonly used both for eduction and induction. By which means, a reduction is made in the size of the engine; a saving of power is effected, and a diminution of friction; less wear and tear occur, and less destructibility of materials. And lastly, the joints, by Mr. Perkins' peculiar mode of connecting, are more easily made secure, and tight, even with the steam at the pressure of 1000lbs. to the square inch, than the joint of the low pressure condensing engines."

This is all the information, that we are at present enabled to afford upon this interesting subject; the specification will not be enrolled until September; we shall then take the earliest opportunity of laying the invention before our readers, with all its details, and in the mean time should any further information transpire, we shall not allow it to pass unnoticed.

Newton's Journal, (London.)

Believing that Mr. Perkins and Mr. Hazard have, in the preceding pages, insisted on the *principal* cause of the explosion of steam boilers, and being convinced that the effectual prevention of these horrible catastrophes would be a great blessing to mankind, and would remove the only important objection which exists against the general use of steam power, it is with particular pleasure that we introduce to our readers the following communication from Mr. Doolittle. We have seen the working model, and cannot discover any defect either in the principle or practical operation of the machinery. Such is the opinion also of an eminent mathematical and mechanical philosopher who has examined the instrument.—*Editor of the Am. Journal.*

Art. VIII.—*Description and specification of a Hydrostat, or apparatus intended to secure a constant and uniform supply of water in Steam Engine Boilers; by* Isaac Doolittle, of Bennington, State of Vermont.*

Let a stop cock be placed in the feed, or supply pipe within the boiler, so as to admit or intercept the passage of water to the boiler at pleasure; let a pinion be adapted, and secured to the prolonged axis of the stop-cock, let a floating body of convenient shape be placed within the boiler; to this body attach a vertical stem having a ratchet on one side to gear into the above mentioned pinion; let it be so geared that when the water is at its proper height the cock shall be closed and no more water admitted; but as soon as the quantity of water in the boiler shall be in any degree diminished, the floating body will descend with the surface of the water, and as it descends the ratchet will open the cock and admit a fresh supply. It is evident that the weight and volume of the floater must be proportioned to the effect intended to be produced: it is probable that the plano-convex form will be most eligible; as the segment of a sphere, with

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* Bennington Iron-Works, April 28, 1827.

Benjamin Silliman, Esq. New Haven.

My Dear Sir,—Some two years since, when the boiler of a steam boat *collapsed* on the Hudson, I communicated to the editor of the Troy Centinel an idea which occurred to me of a method for preventing similar accidents in future, if, as seems now to be the general belief, those accidents are justly attributable to the want of a sufficient quantity of water in the boiler at the time of their occurrence.

I am not informed that any person has applied that idea to practice; and the late lamentable accident on board the "Oliver Ellsworth," has led me to reflect more on the subject; and feeling, as I do, perfectly sure that the very simple piece of mechanism which I have contrived, and which can be applied, with very trifling expense, to any of the boilers now in use, must and will fully answer the purpose for which it is intended, viz. to secure a constant and uniform supply of water in the boiler, as long as the engine is at work. I have determined to apply for a patent for the improvement; and I now send you a copy of the specification, with a sketch of the apparatus, which, if the subject matter seems to you as important as it does to me, I beg you will insert in your Journal. I am, Sir, with high respect and esteem,

Your obedient servant,

I. Doolittle.

the convex side downwards; its specific gravity should be such that not more than one half or two thirds of its volume shall be immersed.

At any convenient place on the feed or supply pipe, between the forcing pump and the boiler, let there be adapted a vertical waste-pipe, at the top of which there might be a valve loaded with a weight greater, per square inch, than the expansive force of the steam intended to be used, so that, whenever the stop-cock shall be opened, the waste valve shall be closed and the water forced into the boiler, and when the cock is closed, the waste valve shall open at each successive stroke of the forcing pump, and allow the surplus water to escape into a pipe arranged for the purpose of conveying it away from the engine; it will readily be seen that the supply pump must always be kept working when the engine goes, and must force a quantity of water somewhat greater than is required to supply the boiler.

If the above apparatus is to be applied on board steamboats, where it is feared the agitation of the water in the boiler, caused by the motion of the boat, should derange the operation of the floater, let the floater be surrounded by a sort of cistern which shall be secured to the bottom and extend to near the top of the boiler, which cistern shall have a small opening near the bottom and be entirely open at the top, the pressure of the steam within and without the cistern being equal, the general level would be maintained within, while the smallness of the lower aperture would prevent any sudden influx or eflux of water from raising or lowering the floater more than that general level would require. The stem of the floater should be continued through the lower or convex side, and traverse a guide so placed as to answer the double purpose of keeping the stem in its proper place, and of preventing the floater from sinking lower than to open the entire aperture of the cock, the top of the stem may also pass through a guide to preserve its position, or the verticality of the stem may be maintained by any other of the methods now used for preserving parallel motion.

Instead of the ratchet and pinion, a chain and counter weight may be used, or the stem of the floater, may be attached to a crank on the axis of the stop-cock, though I think the former method preferable.

I do not claim, as new, any single or detached part of the above apparatus; but I do claim as new the combination and application of the several known mechanical principles herein described, to effect the object above specified.

I. Doolittle.

Bennington Iron Works, April 24, 1827.

Art. IX.—*Note on the doubtful reptils, by* Daniel H. Barnes, *in a letter to the Editor.*

TO PROFESSOR SILLIMAN.

New-York, July 12, 1827.

Dear Sir,—Since the publication of the paper on 'Batracians,' in the 11th volume of your Journal, the question concerning the *maturity* of several of our reptils which were formerly "doubtful," seems to be settled. The Axolotl is acknowledged to be mature, and the Proteus of the Lakes is no longer a larva, as indeed was proved before the publication of that paper. On the subject of the Proteus some new light has lately been shed, which it is the principal object of this letter to communicate.

When I visited Lake George and Lake Champlain two years ago, I made very particular inquiry after the "water Lizards." They are not found in Lake George, but a waterman there gave me information that they were caught at the falls of the Onion River, in Vermont. By asking a variety of questions on other subjects, I satisfied myself of his intelligence and accuracy, and I went to the falls with strong hopes of obtaining Schneider's animal. I inquired for fishermen, and was directed to one who was deemed expert. He informed me that he had very often caught six or *seven* in a night. As it was not the proper season, I engaged him to search, and if possible, obtain the animal for me. This information I communicated to my friend Mr. G. W. Benedict, Professor of Chemistry in the University of Vermont, and the following extract of a letter, lately received from him, will show that he has pursued the subject to a very gratifying result.

Burlington, July 6, 1827.

Dear Sir,

I received early in the spring a copy of your paper on the doubtful reptiles, for which I thank you. As to the specimens of the Proteus which you hoped to receive from *Chiotte, I fear you will be disappointed, at least for this season. I went to see him yesterday, to learn whether he had been successful in his endeavors to obtain some of them. He said that he had spent several days in fishing for them, both at the falls and at the mouth of the river, but had caught none, nor did he think it probable that he should succeed before next spring. Another fisherman, early in the season, caught *seven* in one night, which were sent to me by a gentleman at the falls, whom I requested to obtain some for me, if practicable. I kept these alive several days: but from their confined situation, (all of them having hooks in their stomachs with lines attached,) I could learn little of their habits. I have thought a few remarks on their appearances, both exteriorly and interiorly, as appeared from the dissection of one of the largest, might not be unacceptable, especially if you have never seen any alive. I would notice, in the first place, that the figure in Silliman's Journal does not well represent the animal, in several particulars.

1. The *color* of the *living* subject is very different. The *ground* color on the sides and back is bluish gray, but so thickly spotted with minute dull yellow spots as to appear, at a little distance, grayish-yellow—the belly approaching nearly to white. Spots of dirty blue considerably darker than the ground and about one fourth of an inch in diameter, are scattered all over, usually without any regularity, though occasionally presenting rows. On immersing them in alcohol, the color of the abdomen is so altered as to approximate, (though not very closely,) to the figured one above referred to.

2. The forehead is much *flatter* in my specimens, than is represented.

3. The eyes, (black,) are distinctly on the *side* of the head and *far* apart, nearly twice as far as appears on the plate.

4. The appearance of the branchiæ is totally different. Those figured in the Annals of the Lyceum are pretty well drawn, but the filaments are longer in the living animal and more expanded. These *tufts* were of a DEEP AND SPLENDID CRIMSON. The alcohol destroys the color entirely, and in one specimen which, (apparently from the wound of the hook,) was nearly dead when I received them, the color was much like the ground of the body. The animal keeps these in mo-

* The Fisherman.

tion AS A FISH DOES ITS GILLS. In bringing them down *to the neck*, the filaments are brought pretty close to the fleshy branchiæ, on elevating them the fimbriæ dilate and float, as it were, in the water, *presenting*, *from the beauty of their color and gracefulness of their motion*, AN APPEARANCE BEAUTIFUL BEYOND DESCRIPTION. The largest specimen was thirteen inches in length, the least about eight. * * * * * I would notice that in the figure in the Annals of the Lyceum, the head is *sharper*, that is, the snout is *narrower* than in those which I have. The general appearance indicates a more *active* animal than the appearance and movements of my specimens would authorize.

On dissecting one of them precisely *thirty-eight vertebers* were discovered, nineteen of which belong to the back and neck. I notice this particularly from your having dwelt on it in your interesting paper. Professor Sweetser of the Medical school dissected it for me.

There is no indication of the *vitta* from which the specific name was given. It seems to me that if that character is not general *it would be well to change the name.*

With much respect yours,

GEO. W. BENEDICT.

The letter from which the foregoing extract was taken, was written with a modest apology that it might *possibly* interest *me*, and was not intended for publication; but as it contains important information which the scientific world ought to possess, I know the author's goodness will pardon me for giving it the present direction.

Here then we have authentic information, from a source that will put the subject beyond a doubt. Schneider's animal came from Lake Champlain. Here *seven* are caught in one night. Schneider's animal was discredited, and believed to have been mutilated. Here two Professors of the University watch the motions of the living animals for several days, and then dissect one of the largest, which in every material point exactly coincides with the published description of the Proteus Lateralis. On the subject of the name I agree with Professor Benedict, that it should be changed. Dr. Mitchill has latterly called it *Proteus* MACULATUS, which, as it is a good descriptive name and comes from *the right* source, I am disposed to adopt. (See vol. xi. p. 287.)

Amphiuma Tridactyla. *Cuvier.*

Cuvier has lately described a new species of Amphiuma which he calls Amphiuma *tridactyla*, from its having *three* toes. It came from America. He repeates the remarks made in this Journal vol. xi. p. 296, that others will probably be discovered; and the remark on p. 297, that, prejudice apart, they are all good food. I confidently expect another species of *Siren*, and the "*long black water lizard*" of Lake Champlain, mentioned in vol. xi. p. 287, of which I had as good information as of the *Proteus Maculatus* in the Onion River where, as above stated, it has since been caught. I hope Professor Benedict and his learned associates will pursue the search, and fully explore the interesting and productive regions bordering on the Lakes in their vicinity.

Protonopsis Horrida. *Barton.*

Concerning the "*Menopoma*" I am convinced that the name of Dr. Barton has, and of right ought to have the preference. He had the animal very finely figured, and first made it known to our naturalists under the name of *" Protonopsis *horrida*." By Protonopsis we understand an animal *like the Proteus.* Whether the name is a good one or not, we stop not to inquire, but simply remark that the two animals were generally confounded until Capt. Le Conte's paper on the *Siren striata*, was published, in the Annals of the New-York Lyceum of Natural History. For the suggestion of this correction I am indebted to Professor Jacob Green of Philadelphia. The error arose from the difficulty of obtaining specific information from the papers of Barton, which were published in a fugitive form, and have long been out of print. This difficulty is now obviated by the direct and positive testimony of one of the most accurate naturalists of this country. It is as above stated, and the animal must hereafter be called Protonopsis Horrida, of Barton.

Siren Lacertina. *Linné, Garden.*

The question, concerning the respiration of the Siren, and its congeners, is still agitated. Cuvier has expressed an opinion that they have a double set of respiratory organs. Professor J. A. Smith, of the Medical College in this city, is of opinion that all the blood of the animal passes through the

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* See Vol. xi. page 278, of the Am. Journal of Science and Arts.

tufts of the branchiæ; but by others this is doubted. CAPT. LE CONTE has dissected a large Siren *alive*, and has actually seen the expansion and contraction of the lungs in the act of respiration, just as in the frogs and tortoises; and he has also made a beautiful preparation of the lungs, by inflating them with air and drying them in that state. They are *true lungs* and not merely *air-sacks*, and their connexion with the heart and arteries was distinctly observed. This is an important fact, and it will be duly appreciated, and placed to the credit of that very accurate observer, to whom, in various ways, natural science is already so much indebted. It is hoped that the learned Professor of the University of Vermont who dissected the Proteus Maculatus, as mentioned above, will, by the dissection of a number of *living* specimens, finally settle this long contested and doubtful question. He has, what very few other competent persons can have, the means at hand, and we hope that zeal and industry will not be wanting.

Your cordial friend,

D. H. BARNES.

ART. X.—*Notice respecting Magnetic Polarity; by* D. H. BARNES.

TO PROFESSOR SILLIMAN.

New-York, April 16, 1827.

DEAR SIR,—Professor Eaton's demonstration, of the fact, that the fitful variation of the compass is caused by the magnetism of the card, gave us great pleasure, and the simple and efficient remedy which he has found, is no less honorable to himself than beneficial to the community. Mr. Patten, of this city, had discovered the same fact in a compass which he had proscribed as unsalable, and laid by as useless. Trying this compass with its proper needle, we observed that in turning the compass slowly and steadily around, there was one point to which the needle would cling, until the compass was turned full ten degrees. The needle would then start off, suddenly, to the proper point, and traverse correctly until again interrupted by the point of attraction in the rim. The same compass was then tried with a *short* needle which lay perfectly still, and pointed with the utmost exactness, while the compass was turned entirely round. While trying these experiments, Mr. J. Dodge of the Western High School of Rochester, took the (iron?) window bar which lay near it, and placing it perpendicularly found that the *lower* end was a north pole. He inverted the bar and was surprised to find the *same* result, that is the poles were *instantly changed by inverting the bar.* He invited me to try the experiments with him. I did so, and after verifying the fact of the instant inversion of the poles, by the change of the position of the bar, I was led to inquire at what degree of elevation this change takes place. There must be some point at which the poles first become inverted and there must be some *neutral* point, or medium between polarities directly opposite. The idea struck me so forcibly that I immediately set about a series of experiments which produced the following results.

Experiment 1. An iron bar was laid on the meridian due north and south.

Result. It showed strong polarity.

Exp. 2. The *south* end was raised to the Zenith.

Res. No change took place. The needle at the bottom was steadily attracted as before.

Exp. 3. The top of the bar was carried over from the Zenith to the north point of the horizon.

Res. The needle was inverted.

Exp. 4. The *north* end of the bar was raised to the Zenith.

Res. The needle was inverted.

If then the bar, raised from the *south*, traverses through 180 degrees, and becomes inverted; and the same bar raised from the *north*, traverses through 90 degrees and becomes inverted, the changing point must *divide the difference;* accordingly,

Exp. 5. The *north* pole was slowly raised, in the progress of which the needle quivered, became unsteady, and at 45 degrees was inverted.

Again if the needle is *inverted* at 45 degrees there must be a neutral point and this again must *divide the difference;* accordingly,

Exp. 6. The north end of the bar was raised to 22½ degrees;

Res. And it exhibited no signs of polarity, being from end to end simply an attracting point to either end of the needle.

Exp. 7. The bar was laid due east and west, or at right angles to the meridian.

Res. It exhibited no signs of polarity.

I anticipated the next conclusion, that the change of polarity would *divide the difference* between 45 degrees and the commencement of the scale; accordingly,

Exp. 8. Giving the compass to Mr. Dodge and holding the instrument to measure the angle, I raised the bar from the *east* $22\frac{1}{2}$ degrees and said without looking at it "now the needle is inverted." "True," said he, "so it is."

The curious and interesting result then is, that a plane elevated from the north, at an angle of twenty-two and a half degrees, and cutting the horizon in a line due east and west, is a *neutral* plane or magnetical *equator*, and that a bar revolved on this plane shows no polarity, and if the bar makes with this plane on the upper or *south side* any angle equal to twenty two and a half degrees or greater, the lower end is the north pole; and if the bar makes on the under or *north side* of the plane, a less angle with the plane of the horizon than the magnetical equator makes, the end which touches the equatorial plane is the south pole. Whether these results are uniform in various parts of the world, or whether there are such lines as magnetical *tropics*, on each side of the magnetical equator, as the above results seem to to intimate,—whether the magnetical equator is the same in different latitudes, or varies its position according to latitude, future experiments must determine.

Dr. Gilbert has mentioned the fact that opposite ends of an iron bar equally affect the magnet, and in the same way, and he accounts for the fact by supposing that the earth magnetises the bar instantaneously.

Is then the common remark, in the books, that a bar becomes magnetic by long standing in a vertical position strictly true? And will not any such bar instantly change its polarity by being inverted?

Should any of these facts or experiments appear to yourself to be new or useful, they are at your service for publication in your valuable Journal.

Yours most truly,

D. H. Barnes.

We learn from Mr. Barnes, that at the time of writing his paper, he had not seen the remarks in our last number, (page 232,) signed, A Surveyor. He considers them as a covert and improper attempt to depreciate a valuable discovery, and as conceived in an improper spirit. In inserting them, we were not impressed with any other idea, than that a practical man was urging a fair criticism respecting an innovation requiring great caution, and which was therefore a proper subject of examination. We trust that it will be the means of producing additional experiments, and that in the end, the cause of truth—which should be the great object of all our labors, will be promoted.—*Editor.*

July 20, 1827.

Art. XI.—*Reply of* Mr. Quinby *to Mr. Blake's criticism on his demonstration of the Crank Problem.*

To the Editor.

Sir—In answering the criticism of Mr. Blake, in the recent number of your Journal of Science and Arts, on the demonstration which I gave of the *crank problem*, it is only necessary to point out two misrepresentations which he has made in the remarks he has offered.

At page 341 he says, "But it appears from a part of Mr. Quinby's reasoning, the truth of which is admitted by his opponent, that when CD represents the whole degree of force exerted by the shackle bar on the crank, or, which is the same thing, (the shackle bar being perpendicular,) the whole degree of force exerted by the steam on the piston, then CG represents the *mean* tendency to rotation in the crank which that force produces."

In the reasoning, to which Mr. Blake refers, it is demonstrated that when *CG*, (not CD,) represents the "tendency which P has to produce rotation," *CG also* represents the "*mean* tendency which P′,=P, has to produce rotation in descending in the arc ADB."

The second misrepresentation, which Mr. Blake has made, is in supposing that the whole force and the *mean* force are applied at different distances from the centre. In the demonstration which I gave I reduced the problem to the case of the simple Pully, (or wheel and rack,) and supposed the whole force and the *mean* force to be applied at the same point G.

Since I reduced the problem to the case of the simple Pully, (or wheel and rack,) and in *that case* considered the space through which the power moves, it is plain that the demonstration which I gave is not liable to the objection which Mr. Blake has stated. The demonstration, however, would be equally satisfactory if nothing had been said about the space through which the power moves; for since the problem is reduced to the case of the Pully, and the *mechanical power* of the Pully is *known*, it was unnecessary, (for the purposes of the demonstration,) to mention the space through which the power moves. My reason for mentioning the space through which the power moves, was merely to show, to those who are not well acquainted with mechanics, what is understood to be a case in which there is no loss of power. When a machine is reduced to any of the simple mechanical powers, it is then *known* that there cannot be any loss of power; and it would be unnecessary to repeat what every tyro in mechanics already knows, that in all the simple mechanical powers, *what is lost in force is gained in space; and what is lost in space is gained in force.*

A. B. Quinby.

June 14, 1827.

Note.—In the demonstration which Mr. Blake has given, he has compared the "whole degree of force exerted by the shackle bar on the crank," with the "*mean* tendency to rotation in the crank which that force produces." The "tendency of a force to produce rotation," is the product of that force and the distance at which it acts from the centre of motion. The things, therefore, which Mr. Blake has compared are not of the same kind; and he has fallen into the very error of which he accuses me. The quantities which are compared in the demonstration which I gave are, "tendency of P to produce rotation," and "*mean* tendency of P to produce rotation." These are of the same kind. At page 339 he says, "Another [power] will drive a body against a resistance ten feet;" this he states contains but *two attributes*; but can a body move ten feet without occupying some portion of time? and if it occupy *any* portion of time, does not this example contain the *three attributes?* How then does Mr. Blake find the same difference between *this* example and the *third*, that there is between a *square* foot and a *cubic* foot?

A. B. Quinby.

Art. XII.—*Answer to* Mr. Quinby.

To the Editor of the Am. Journal of Science and Arts.

Sir—The absence of argument in Mr. Quinby's reply, (in the last number of your Journal,) to my examination of his discussion of the crank problem, is so evident, that had not misrepresentation been used, I should not have desired to be heard in defence of the principles asserted in that examination. That such has been the case will appear in the course of this paper.

I will first notice what Mr. Quinby says relative to my demonstration of his failure in an attempt to prove the incorrectness of a principle assumed by Mr. Ward as applicable to the crank problem.

Mr. Quinby says "the writer next undertakes to demonstrate that, in my reasoning to prove that the principle assumed by Mr. Ward is incorrect, I committed an oversight, which altogether destroys my 'demonstration of the crank problem,' and then *gravely* adds, "But on this subject, I may remark, that there is no connexion between my strictures on the principle assumed by Mr. Ward and my 'demonstration of the crank problem.'" No such remark as that attributed to me occurs in the course of my examination. The words which close the paragraph, in which Mr. Quinby's strictures on Mr. Wards principle are criticised, are these: "and the remaining part of Mr. Quinby's demonstration, founded upon this assumption can be of no avail;" what demonstration? certainly not that of the crank problem, but the "demonstration founded upon this assumption," (see Vol. XII. No. 1,) clearly the very one under consideration, namely, Mr. Quinby's attempt to demonstrate that the principle assumed by Mr. Ward is incorrect. Next Mr. Quinby admits that he failed in his attempt to prove the incorrectness of Mr. Ward's principle, but is *amused* that the author of the examination should have fallen "into an error much greater than the one he is endeavoring to correct:" in a note he says, "It is possible that the writer of this examination intended that the terms of these proportions should be taken alternately. In that case his demonstration would be true." Here it is only necessary to state that Mr. Quinby was furnished with a copy of those parts of the errata of Vol. XII. No. 1, which apply to my communication, and in which this very error is noted and corrected: he *knew* that the terms of the proportions were intended to have been written alternately and not in the form in which they appeared, and should not have taken advantage of such a mistake to have avoided the acknowledgment, that his error was pointed out: had he received no correction of these proportions, the remarks which followed them would have been of themselves sufficient to have shown the intention of the writer of the examination. No credit was claimed by me for the discovery of an error which required but a slight knowledge of Plane Geometry to detect.

The next paragraph of Mr. Quinby's reply contains a demonstration of the incorrectness of Mr. Ward's proposition: the paragraph closes in this way, "therefore the principle assumed by Mr. Ward is not correct, and my proposition, which the writer of this examination asserts is incorrect, is true:" no such assertion is contained in my examination, the words used in relation to this proposition are these, "but first let me remark upon the manner in which Mr. Ward's proposition, relative to the crank, is treated by Mr. Quinby"—the *manner*,—it did not enter into my plan to touch upon Mr. Ward's proposition further than to expose Mr. Quinby's error in his manner of treating it.

Mr. Quinby then takes the equation $\Phi R = Px$, (in which Φ represents the effective force, R the radius of the crank wheel, P the power applied to the crank, x the perpendicular from the point of application of the force to the vertical diameter of the crank,) given in my examination of the crank problem, to the mode of solving which, he objects; he observes, "In the equation $\Phi R = Px$, he, (the author of the examination,) has two variable quantities; and he supposes one of them to be equal to a *constant* quantity,"—not so,—in the equation $\Phi R = Px$, Φ and x are variables, R the radius of the crank is a constant, and P, by the terms of the question, is considered as a constant force applied to the extremity of the radius of the crank wheel; then Φ must vary with x, and must have its mean value when x is a mean: this was the mode used to solve the equation and to find the mean value of Φ, and to this mode I can see no objection. Mr. Quinby further says: "The equation, however, which he," (the author of the examination,) "has given, will solve the problem; and gives the same result as that which I gave in my demonstration; for since $\Phi R = Px$, and this for any position whatever of the crank, it is plain that there can be no loss of power, for if there be a loss of power, there must be a loss at some point; but there is not a loss at any point, and therefore there is no loss of power:" certainly, "there must be a loss at some point," the equation shows that loss; $\Phi R = Px$, gives $\Phi = \frac{x}{R} \times P$, x being less than R at all points except the extremities of the horizontal diameter of the crank wheel, $\frac{x}{R}$ must be a fraction at all other points of the revolution, showing clearly a loss of power in transmitting it by the crank. By examining this equation $\Phi R = Px$ it will be seen that from the *dead points* where $x = o$ and of course $\Phi = o$, Φ goes on increasing until $x = R$ at the extremity of the horizontal diameter, which results correspond plainly with the case in practice.

Mr. Doolittle, (see his letter in the last number of the Journal,) will be convinced that his equation $P \times .6366 \times$ semi-circumference $= \Phi \times$ diameter, does not apply to this question, if he will consider that it has been proved that the case in practice may be resolved into one in which the shackle-bar shall remain vertical, and the power be applied to every point of the circumference of the wheel, giving the equation $P \times .6366 \times$ semi-circumference $= \Phi \times$ semi-circumference, or $\Phi = P \times .6366$, the same given in my examination as showing a loss of more than one third the power applied.

Art. XIII.—*Sketches of the Geology, &c. of Alabama; by* William S. Porter, in a letter to the Editor.

The Alabama river is navigable for steam boats to the junction of the Coosa and Tallapoosa. A few miles above this junction the rapids commence on the Coosa, and continue at intervals for sixty miles. These rapids are all passable for boats during high water, and an engineer has reported that by opening the river it may be made navigable at all seasons of the year. Above these rapids, the river is deep, smooth and perfectly navigable for two hundred miles, to near its source in the valley of the Tennessee river, a navigable branch of which, almost communicates with it. The Coosa passes through an extensive valley, known by the name of the *Coosa valley*. Whether this valley is interrupted at the rapids by mountains I am unable to say. If so, the elevation cannot be great, for waggons which pass from the valley to the market towns on the Alabama, carry as heavy loads as those that pass through only a level country. The engineer also reported that a canal might easily be made around the rapids, which would not probably be the case if there were mountains crossing the river. From these facts, and from the nature of the country which I saw, some twenty miles west, I conclude that the primitive mountains terminate east of the Coosa river. From the junction of the Coosa and Tallapoosa, the Alabama river pursues a westerly course one hundred miles, or about fifty, in a direct line to Cahawba. The banks are very high, more than fifty feet above low water, to which height the river often rises in the winter. The banks when they present a recent surface, exhibit a beautiful appearance, striped with alternate layers of gravel and different colored clays. The clays commence about twenty feet above low water. The layers are of different thickness from one inch to several feet, and of various colors, from red and deep blue to a delicate white. The white is sometimes so pure, that the people use the substance for paint. The gravel stones in this region are mostly very small. Two specimens resembling flint, I picked up among the pebbles. Beautiful shells, of which I send you specimens, are found particularly in the islands of the river, and some which I saw are large and exhibit a most magnificent play of colors. I intended to have procured some of the finest, but owing to ill health, I was prevented. The specimen of limestone is from the prairies nearly west from Cahawba. Much shell limestone is found in the region some distance south. Salt springs are found about half the distance from Cahawba to Mobile, from which much salt of a superior quality is made. Leaving the Alabama river in the centre of the state, and proceeding north towards Huntsville, the country is somewhat hilly with few rocks to be seen for forty-five miles, where is a hill of large boulders of granite, but none in place. The first rock in place is seen at Wilson's Hill fifteen miles farther north. Here we find the common secondary gray limestone. For the next seventy miles, the country is mountainous or rather hilly, with elevations of three or four hundred feet above the valleys. The limestone continues associated with sandstone of different shades of red and gray. For the next sixty miles to the Tennessee river, the country is level, but very elevated; rock, almost exclusively sandstone. The descent to the Tennessee valley, is about a mile in length, and very steep. On the side of the mountain the rock is chiefly limestone. The valley of the Tennessee here extends into the state of Tennessee. It is a beautiful, fertile and highly cultivated country, in the midst of which, is the flourishing and beautiful village of Huntsville. In the south part of Tennessee south from Nashville there are high mountains of limestone on some of which are the most stately cedars. On the tops of some of these mountains and also on the tops of the mountains in Alabama, we find occasional ridges of very recent clay slate. The specimens of petrified shells I send you, were taken from a hill about thirty miles north from Nashville. The slate decomposes and turns into clay, and the shells tumble to the bottom. Yours,

Prof. SILLIMAN. WILLIAM S. PORTER.

ART. XIV.—*Animadversions on Mr. Genet's Memorial on the Upward forces of Fluids, and on his "reply to Dr. Jones, in the Franklin Journal;" by* THOMAS P. JONES, M. D., Editor of the Franklin Journal, and Professor of Mechanics in the Franklin Institute, of the State of Pennsylvania.

"THE BASELESS FABRIC OF A VISION."

To the Editor of the American Journal of Science and Arts.

SIR—Editors, it appears, are sometimes "not only witty themselves, but the cause of wit in others." Thus it seems that a note of yours, called forth the reply of Mr. Genet to my remarks on his Essay; and I can assure you that but for the importance given to the subject of that memorial, by its analysis in your Journal, I should have spared myself a very large proportion of the labor which I have now undertaken; but when even "airy nothings" obtain "a local habitation and a name," they derive from this circumstance, an artificial importance which no other could have obtained for them.

The readers of your Journal are informed through the medium of Mr. Genet's communications, that I have, in the Franklin Journal, controverted this opinion of that gentleman as presented to the scientific world, in his "Memorial on the Upward Forces of Fluids;" but, in making a further appeal on this subject to public opinion, it is so manifestly desirable that both parties should be heard before the same tribunal, that I feel assured you will allow me to occupy a few of your pages for that purpose. I agree perfectly with you sir, that the legitimate end of controversy is the discovery of truth, and that in conducting it, personalities ought to be avoided; should I not in this communication steer more clear of these, than has the gentleman to whom I am replying, I shall only add one other to the numerous proofs, that we are very indifferent judges where self is a party.

Mr. Genet has, in your Journal, brought against me sundry charges, of some of which I deem it necessary to take notice, as the Franklin Journal is not in the hands of many of your readers. I am not so vain as to expect to convince Mr. Genet that he has himself committed the error which he ascribes to me, but I may, perhaps, succeed in proving this to "impartial judges." In speaking of my first notice of his works he says, (vol. 11, p. 102.) "But I find, that excepting a few additional acerbities, and ungenteel allusions to my advancing age, the Editor has," &c. The following is the only passage in my Journal, to which it is possible he can allude. "We were, however, unwilling to interfere with the whimsies, and to disturb the reveries, of a very respectable man, who, probably has cherished fond hopes of this child of [his] old age; it was the more unpleasant to us, as we have had some personal knowledge of the gentleman, and have respected him highly." (Franklin Journal, vol. 2, p. 44.) Few persons, I apprehend will find in this language, acerbities and ungenteel allusions. It is conceded, on all hands, that there is a legitimate use of ridicule, and that this weapon is very properly employed against extravagance, fanaticism and presumption; not only in religion, but on all other subjects. "Need I cite examples to show, that men in many respects intelligent, have propounded the most absurd doctrines, and supported the most ridiculous projects, particularly on the subject of Mechanics? Such instances are too numerous and too well known to require exemplification." We might at once pronounce the man no mechanical philosopher, who should pursue the phantom, perpetual motion, yet he might be, not only a very good man, but on other subjects a very wise man.

It was my first design to treat the whole scheme as whimsical, unphilosophical, and indeed as ridiculous; and the more I have examined it, the more perfectly I have been convinced that this is the only correct mode of treating it. My reason for now departing, in some degree from this design, may be collected from my preliminary remarks.

In the reply of Mr. Genet, contained in the last number of your Journal, there are several expressions, which, as they are similar in character, I will group together, that the reader may judge whether I may not retort one, at least of the charges brought against me. "The aspersions of my censor, and his uniform subversions, misnomers, and curtailments." "The sneers of Dr. Jones." "Dr. Jones garbles, when he says that I call a vacuum a gas." "The denomination of *gaseous* fluids, which I have given to steam, and not to the vacuum, as the Doctor very unfaithfully quotes it." "Less conceited appellate judges," *et cum multis aliis.*

These charges would be indeed formidable, were they not deficient in the essential property, correctness. I have certainly curtailed because I have not quoted the whole book, but I have not either garbled, subverted, or unfaithfully quoted; neither have I intentionally misrepresented the author's meaning in a single instance.

That Mr. Genet should be displeased with my manner of treating his views is perfectly natural; as he undoubtedly, has the most perfect confidence in them. The more extravagant the theory, the less likely its advocate to be convinced of its fallacy; but although an individual may be *incurable*, the spreading of his disease may be prevented.

Mr. Genet may probably recollect, that about seventeen or eighteen years ago, a number of gentlemen living in Albany, and some of them very learned men, united to build a boat, to be propelled by the motion of a pendulum, urged by the strength of only three or four men. This was to supply the place of a steam engine. A certain Mr. Letton, was the *inventor* of the scheme; and certain intelligent civilians, and other gentlemen of worth and standing *paid for it.* In the *Athens of America*, our sage and wary members of many learned societies, were fain to hang their harps upon the willows, after having sung the praises of Redheffer's perpetual motion, and without claiming inspiration, I fear not to prophesy, that a similar termination will be witnessed, in the *Commercial Emporium*, should its citizens be induced to become "associates for the essay of an hydronaut."

I am aware that in every controversy carried on in a Journal, it is necessary to be as brief as the merits of the subject will allow; I will therefore, at once proceed to notice some of the observations of Mr. Genet in his last 'Reply,' and will afterwards attempt a short analysis of the principal projects brought forward in the 'Memorial,' which has given rise to this disquisition. In doing this, I shall, without an effort, avoid garbling and misrepresentation, and should I call the "submissive philosophy" of Mr. Genet into action, it will neither merit, nor receive my sneers; for, although he may identify himself with his schemes, I shall carefully separate the two; and, indeed, were it not for the respectability of the former, the latter would not have received any public notice from me, however they might have answered for the amusement of an idle hour.

The claims of Mr. Genet, to the important discovery of applying the "Upward Forces of Fluids" as a motive power, in propelling machinery, and to various other useful purposes, have been made known to a very considerable extent, by his friend Dr. Pascalis, in Vol. XI, at page 339, of your Journal; to this article, with the accompanying plates, I must refer those of your readers who do not possess the Memorial itself; as with the aid of the quotations which I may make from the latter, the merits of the controversy will be readily ascertained.

In page 212, 213 of your last number, Mr. Genet has quoted from the Franklin Journal, my animadversions on his description of the vis motrix of the steam engine, and proceeds, through two or three pages next succeeding, to state the great amount of information on this subject which, in the year 1784, he derived from conversation with its great improver, Mr. Watt, "all which," he says, "is perfectly present to my memory, my mental retentive faculties being preserved, by the invigorating exercise of a laborious country life." It must be confessed that the extent of information which he displays, accords with his own history of its attainment, and does great credit to a reccollection of between forty aud fifty years standing; the very reverse of credit, however, would be due to a man who professed to have obtained his knowledge of the engine in the ordinary way, from books, and observation, were his information as meagre as that of our author. The palpable errors committed by Mr. Genet, in his "Memorial," are followed, in his "Reply," by others equally palpable. It may be said, that although the existence of these errors should be admitted, they do not affect the merit of his own inventions; but let it be remembered, that this merit is altogether gratuitous, that Mr. Genet has attempted to run a parallel between his hydronaut and the steam-engine, without understanding the operation of the latter, and that there is but little probability, that one who has, manifestly, not only forgotten what he must once have known, but who has ceased for forty years, to keep pace with the improvements in mechanical and chemical sciencc, and their practical application, will present the world with any of those great discoveries, which involve a long train of reasoning, and correct theoretical and practical knowledge. In the race of improvement, the starting point should be the goal at which others have arrived.

I have asserted that Mr. Genet is not acquainted with the structure, and operation of the steam-engine, and it is incumbent on me to prove the correctness of this assertion; unfortunately for my opponent he has rendered this task perfectly easy. In his "Reply" p. 316, after detailing a portion of the information which he received from Mr. Watt, he says, "None of the subsequent improvements were omitted by Mr. Watt, to show the gradual progress of the steam system of mechanics, and reach his own improvement; *in the first place*, upon the open ended cylinder, in which the expansive force of steam was employed to raise the piston, which in its fall, after the destruction of the steam, as I have stated it, became, under the pressure of the atmosphere on the piston, and the weight of the said piston, the *available force. And in the second place*, upon the tight cylinder which is constructed in such a manner, that on one side, instead of the atmosphere, the steam is made to press on the piston, whilst on the other side the cylinder is open to the condenser.

"This summary description of the two different modes of guiding and using the power of steam, improved in succession by Mr. Watt, and which have both their respective advantages and disadvantages, and are both in use, will, I presume, Sir, satisfy you and your readers, that, in the critique of the parallel which I have drawn between the operation of the steam-piston in an open cylinder, and my hydrostat, equally placed in an open cylinder, Dr. Jones has proved either his ignorance of the difference between the open ended cylinder, practically called the *atmospheric engine*, and the tight cylinder, called the *double acting engine*, or that he has purposely selected the complicated operation of the double acting engine, in which the pressure of the atmosphere is no more used, or of the high pressure engine, (in which, on account of its overwhelming force, the pressure of the atmosphere is not taken into account, and the cylinder is left open to the air,) for the *unfair* purpose of showing that my parallel was incorrect, and my definition of the steam-engine injudicious. Had he known, or *candidly* considered, that in the open ended cylinder the direct force of the steam goes only to raise the piston, and that the expansive force of that steam being condensed, the vacuum created determines the fall of the piston, under its own weight and the incumbent pressure of the atmosphere, equal, on every square inch of the area of the piston, to 15 pounds, he would not have asserted, 'that the pressure of the atmosphere and the weight of the piston were not necessary to Mr. Watts' engine, and served only to abstract from its power.'

"There is in reality no pressure of the atmosphere in Mr. Watts' double acting engine,* which Dr. Jones has here in view. But if there is none, how can it abstract from its power? And again, if the piston works in the vacuum, as Dr. Jones has told us it did, what difference can its levity or its weight make in its power, if in vacuo, according to Newton, the gravitation of a feather and of a ball of lead, compels them to obey, with the same speed, the proportionate force that draws them towards the center of the earth?"

Some of those who know me intimately, will smile at the idea of my being charged with ignorance upon the subject of the steam engine, by one who could write such paragraphs as those just quoted. But it must be remembered that this is from the pen of one who "is not a philosopher of common stamp," a member of several learned societies, and one who has been the pupil, and the associate, of men who have greatly enlarged the boundaries of science; who have illuminated the world by their discoveries. Let all this have its proper weight, as it appears to form one of the strongest points in the argument of my antagonist.

Mr. Genet says that "Dr. Jones has proved, either his ig-

* Except on the area of the section of the piston-rod.—Ed.

norance of the difference between the open ended cylinder, practically called the *atmospheric engine*, and the tight cylinder, called the *double acting engine*, or that he has purposely selected the complicated operation of the double acting engine, for the *unfair* purpose of showing that my parallel was incorrect, and my definition of the steam engine injudicious." Had this paragraph been penned by some injudicious friend to Mr. G. I should have been inclined to have exonerated that gentleman from the tissue of error which it involves; but it is from his own pen, and must, therefore, be treated accordingly.

Let us first ascertain who *selected* the double acting engine, as the subject of comparison, for the *unfair* purpose of showing the parallel to be incorrect. In page 61 of his memorial, in the very paragraph in which Mr. Genet runs the parallel, he says, "Now let us examine if by mechanical means, we can avail ourselves of the upward force on an hydrostat, with as much advantage as Mr. Watt has availed himself of the downward force of the piston, and weight of the steam engine, to procure the rotatory motion, so ingeniously and successfully applied by Mr. Fulton to navigation. But before I avail myself of the Hydrostatic power to accomplish that object, as I intend to proceed step by step, (*pari passu*,) in a parallel line with the steam engine, I must first settle a perfect balance of forces between us, and take as a pattern one of the largest boats plying on the Hudson, for example, the Chancellor Livingston."

That Mr. Genet supposed the engine on board the Chancellor Livingston, and the other boats on the Hudson, to be acted upon by atmospheric pressure, is evident, and this certainly gives a degree of consistency to his remarks, although without this admission they would be altogether inexplicable. Will Mr. Genet inform me in what part of the United States I can see an atmospheric engine? Will he point out any engine, in any part of the world, in which Mr. Watt has availed himself of this power? or of "the downward force of the piston, and weight of the steam engine, to procure the rotatory motion"?—The fact is, that one of the earliest improvements of Mr. Watt, and one made long before he had contrived the double acting engine, was the abandoning, altogether, the employment of atmospheric pressure, as a motive power. Yet notwithstanding this fact, which Mr. Genet might undoubtedly have learned from many volumes in his own library, hear what he says, "The two different modes of guiding, and using, the power of steam, improved in succession by Mr. Watt, and which have both, their respective advantages, and disadvantages, and are both in use." &c. &c. I do not suspect that this is "*unfair*" on the part of Mr. G. or that he has intended to deceive, but I certainly do think that he "has proved his ignorance of the difference between the open ended cylinder, practically called the *atmospheric engine*, and the tight cylinder, called the *double acting engine;*" and also that he is entirely ignorant of the structure of Watt's single acting engine, which requires a tight cylinder; that is, a cylinder closed at top, with the piston rod passing through a stuffing box, just as in the double engine.

I presume that Mr. Genet once knew the action of the old *atmospheric engine;* but if he did, he has now forgotten it. His description of this, is equally incorrect with his account of those of Mr. Watt. When attempting to point out my *ignorance*, or want of *candor*, he says, "Had he known, or candidly considered, that in the open ended cylinder, the direct force of the steam goes only to raise the piston, and that the expansive force of that steam being condensed, the vacuum created determines the fall of the piston under its own weight, and the incumbent pressure of the atmosphere, equal on every square inch of the piston to fifteen pounds, he would not have asserted, 'that the pressure of the atmosphere, and the weight of the piston, were not necessary to Mr. Watt's engine, and served only to abstract from its power.'" Certainly sir, all these things, I did not know, and I *candidly*, or rather confidently, aver that they are not facts. Had this description of the engine been intended as a travesty, its success would have been perfect. I scarcely know how any one could contrive to thread a greater number of errors, on a string of the same length. The direct force of the steam does not go to raise the piston; the steam merely balances the pressure of the atmosphere, and the piston is raised by a weight suspended to the opposite end of the beam, which weight is considerably heavier than the piston itself. The piston does not "*fall under its own weight*, and the incumbent weight of the atmosphere," but, on the contrary, a considerable portion of the pressure of the atmosphere, is expended in raising the heavy counterpoise of the piston. The critique which follows, serves to confirm, fully, this gentleman's want of information upon the subject which he undertakes to discuss. "There is, in reality, no pressure of the atmosphere in Mr. Watt's double acting engine, which Dr. Jones has here in view. But if there is none, how can it abstract from its power? And again, if the piston works in the vacuum, as Dr. Jones has told us it did, what difference can its levity, or its weight, make in its power, if in vacuo, according to Newton, the gravitation of a feather and of a ball of lead, compels them to obey with the same speed, the proportional force that draws them towards the center of the earth?" Here, by fair inference, the fallacy, that the pressure of the atmosphere operates, in Watt's single acting engine, is repeated. We are also asked, how the air of the atmosphere can abstract from its power?—Will not the air pump, which is absolutely necessary to its action, and which consumes no inconsiderable portion of the power of the engine, answer this question for me? Has not Mr. Genet himself answered it, in the following quotation from the very page on which he makes the inquiry? "The air that remains, or that is formed in the cylinder after the condensation, or the air which enters the steam-vessels, with the condensing water, and the gas, air, or steam, which forces itself between the piston and the sides of the steam-vessels, let the collar through which the piston-rod must work, be made ever so tight and close, cannot be drawn out, or excluded, entirely, and will always, in all kinds of engines, oppose a gradual decrement to the descending power of the piston."

The philosophy of the concluding question, is much more modern than that of Newton, or of any other philosopher with whom we are acquainted, with the exception of Mr. G. Newton never confounded momentum and velocity together, but taught that the former was compounded of velocity, and quantity of matter. Where in his Principia, his Optics, or in any other of his works, has he said, that a feather and a large mass of metal, such as the piston of a steam engine, would weigh alike, or descend with the same force, in vacuo? Really sir, it seems that there is more than one person in the world, who might be benefitted by being "condemned to to study again, his experimental and mechanical philosophy."

"Dr. Jones *garbles*, when he says that I call a *vacuum* a gas, and the *vapor of water atmospheric*, but he has not even suspected that I consider atmospheric air as a compound gas." I did not anticipate this charge of garbling, as I gave the whole sentence in Mr. Genet's own words; and if this be to garble, I do not understand the meaning of the word. I certainly might misinterpret, when an opinion is obscurely expressed; in which case, I should wish to be corrected. The following is the paragraph in question. "How does the steam engine perform that operation, how does it create that *vis motrix*, that moving force, which is the mechanical life of the machine? By the alternate increase and decrease of temperature, which produces in the cylinder, two kinds of fluids, the one gaseous, the other atmospheric, by means of which the piston rises and falls." Now it so happens that when the engine is in operation, there is a vacuum on one side of its piston, and steam on the other; it follows, therefore, that if Mr. Genet does not call a *vacuum* a *gas* and the *vapour of water*, *atmospheric*, he, of course, calls the *vacuum*, *atmospheric*, and the *vapour of water*, a *gas;* and from his explanation, the latter appears to have been his meaning; but as I was not aware, that he supposed all steam engines to be atmospheric, I was unable to construe him correctly. It is certainly very "clear, that atmospheric air itself, is a gas;" and assuredly, I would not suspect, that he who has had *Condorcet*, *Bailly*, *Lavoisier*, *Sage* and *Brisson*, for his masters in Chemistry, Mineralogy, and Philosophy, and who was the intimate of Watt, and of Priestley, would consider it as a simple gas; but what are Mr. Genet's peculiar views respecting its compound nature, he has not informed us.

It may be thought that I have extended my remarks, on the errors in Philosophy, and the want of information on the nature of the steam engine, which Mr. Genet so constantly exhibits, beyond the requisite limits; but this prolixity, has appeared to me to be necessary, in consequence of the confidence with which that gentleman has pronounced his opinions; it has also, I think, been imperiously called for, by the charge of ignorance which he prefers against me; whilst, for himself he claims a competent knowledge, obtained "by frequent observations, made on board of our steam boats, and in our steam engine manufactories, on the origin, progress, and improvements of the steam power, and the theory of æriform fluids," and declares, (p. 315,) that he obtained "from Messrs. Watt and Boulton, and particularly from the first, not only the *most extensive* information, on the great improvements which had been made, in applying the gigantic power of steam, to almost all the arts; but also on its beginning, and history, all which is perfectly present to my memory." Here are claims to information and knowledge, which ought, surely, to have been amply sufficient to have sustained him, calm and unmoved, amidst all my "aspersions, unfair subversions, misnomers, and curtailments;" but it has been an easy, though by no means a pleasant task to show, that these high claims are preferred by one whose knowledge is limited to the action of the old atmospheric engine, and, that even in this, it is altogether imperfect.

I had been led, by a friend, to anticipate a very formidable reply to my former strictures on Mr. Genet's work. Although I was fully aware that the ground taken by that gentleman was untenable, yet I confess that I did expect from him something more imposing than the 'Reply' before me. Feeble as it appears to me, it yet covers considerable space, and although I have not attempted to notice one half the errors which it contains, my animadversions have already swelled out to an undesirable extent. I proceed, therefore, to make some remarks upon Mr. Genet's projected *improvements*, and will endeavor to do so without provoking another quibble on his part.

I cannot better describe the claims of Mr. Genet than by quoting the words of his friend, Dr. Pascalis, who, on this subject, has fairly identified himself with Mr. Genet, although this gentleman states, that in speaking of his 'Memorial,' the Dr. has only "claimed for its author, on a subject entirely new, a suspension of censure, and condemnation, until the whole scheme could be matured, and rectified, by actual experiment." Let us, however, hear the claims, in the words of the Dr. himself, and learn if they are thus limited. In Vol. XI. p. 112, of your Journal, he says, "Mr. Genet undertakes to apply the ærostatic power to the raising, or lowering, of canal boats, on an inclined plane, between a water level, and a higher level, with or without water. He will propel boats on a high level, destitute of water, and lower them to a water level. He can raise or lower carriages on rail ways, from one level to another—relieve steam boats, stranded or grounded, &c. Combining also ærostatic and hydrostatic powers, he can raise or lower canal boats, to or from a high vertical altitude; raise vessels stranded, and other heavy bodies, from under water, also on land, by means of hydrostatic cranes. He can direct how to prevent ships from sinking, &c. and finally, he will protect, or guard steam boats, against snags, sawyers, shoals, and rocks."

And "I can call spirits from the vasty deep," but then they will not come when I do call them; and I apprehend that, unless the voice of Mr. Genet be seconded by means more efficient than those presented in his memorial, he will find that matter is, sometimes, as disobedient as spirit.

The basis upon which the assumptions of our author are built, is, that *there is a force in fluids, which urges them in a direction contrary to that of gravity*: and that in consequence of this *upward force*, and independently of the general laws of atmospheric pressure, the motion of a balloon, in ascending, is accelerated as the atmosphere grows lighter, and its pressure is decreased. And that this *Upward force* or "*force of levity*," has been entirely overlooked, or neglected.—Caloric, or the matter of heat, is assumed to be this principle of levity; it is said that it "gives levity to ponderosity, changes the laws of gravity, and denotes by its tendency to reascend to its center of circulation, that gravity is not a positive, but a negative force, that it is not an active, but a passive agent." These are "the new natural powers, put in requisition," and for the application of which, Mr. Genet has obtained a PATENT.

I have looked, in vain, for a single fact, tending to prove the correctness of these assumptions; they stand therefore, in the same predicament with the assertion that, two and two make five; and it certainly would not be deemed wise to enter into an elaborate argument to disprove such an assertion, merely because some estimable, but wrong headed individual had made it. The "Preliminary principles, facts and authorities," (Memorial p. 12 to 22,) furnish no data whatever in support of the existence of his "New natural power," but contain, with the exception of many of those errors in philosophy, which are so thickly scattered over his pages, a number of admitted facts and principles relative to specific gravity; atmospheric pressure; pressure of water; ærostatics; mechanical powers, &c. It was in this part, if any where, that we ought to have been informed, why balloons, if made air tight, should not, after they have reached that point where they shake off their mundane coil, obey implicitly the principle of levity, by which they are elevated, "tending to reascend to its center of circulation," the sun, and fly off to that luminary. Why the atmosphere itself, and all other gaseous bodies, should not rise from the surface of the earth, and, borne upward by their *specific levity*, seek the same center of circulation. Mr. Genet has repeatedly complained, that those who have opposed his views, have made assertions without offering proofs, but, excepting to one in his novitiate, it would be idle to attempt to offer proofs in support of principles generally received. It is Mr. Genet who has failed in this particular; he has boldly attempted to establish a new principle of specific levity; has denied the universality of gravitation; has declared that gravity is not an active, but a passive agent; and made many other assertions equally vague and fallacious, and seems to expect to sustain himself in so doing, without advancing a single step in that rigorous course of experiment, or induction, which true philosophy demands.

Plate 1st, in the Memorial, and in the analysis by Dr. Pascalis is a representation of *an ærostatic elevator to raise and lower canal boats, on an inclined plane.* The force to be applied, is the ascent of an air balloon, (*an ærostat,*) which when allowed to ascend, is to draw up canal boats, by means of a rope fastened to the bottom of it, and passing through a sheeve, or pully, and thence up to the periphery of a large wheel, thirty feet in diameter. A pit is dug, at the bottom of which is the laboratory in which the hydrogen gas is to be prepared; the aforesaid pully, &c. Over the whole, a building is to be erected, sufficiently extensive to contain the large wheel and its appendages; and sufficiently high to allow of the ascent of the *ærostat.* "In reference to the building and its dimensions, if an ascension of 90 feet, producing 900 feet distance, equivalent to 90 locks, was really wanted, the altitude from the bottom of the pit, to the top of the cupola, ought to be 96 feet, allowing six feet under, to attend to the balloon and gas." (Memorial, p. 29.) The balloon, according to the estimate made, if covered with *silk*, and forty-five feet in diameter, will possess an ascensive force of 3236 lbs.; and a canal boat with its load, is estimated to weigh sixty tons.

Waving all remarks upon the total ineligibility of the power proposed to be applied as the first mover, as there is little danger that any engineer, or mechanician, will make an essay of it, I will repeat the question which was originally asked by the Editors of the Boston Journal, "But why not use the descendent force of a leaden weight, as well as the ascensive force of an air balloon?" a question which it has not been convenient for Mr. Genet, or his friend, to answer. The balloon after it has ascended, is to be drawn down again; I beg pardon, "recalled down;" and, I will here ask another question; how much less power will *recall* it down, than that which it exerted in its ascent? and why not use this power to draw up another boat, without troubling the balloon?

In calculating the power requisite to draw a boat of sixty tons, up a plane with a rise of one foot in fifteen; Mr. Genet estimates it at 3200 lbs. Now I had understood, though, to be sure it was according to the *exploded* philosophy, that in order to *sustain* a weight upon an inclined plane, the power which sustains it, must bear the same proportion to the weight, which the perpendicular height of the plane bears to its length; and that consequently in the contemplated plane, it it must be equal to one fifteenth of the load of sixty tons, that is 8,000 lbs. instead of 3,200.; a trifling difference this, and easily obviated by enlarging the house, the balloon and the laboratory, to considerably more than double their capacity; but even then, the whole will be at rest, as we have yet to overcome friction, and to give motion; to effect which, another addition must be made to the power, which shall increase it to about four times the estimate.

The foregoing is, comparatively, a slight deviation from correctness, as will appear upon examining the operation of the wheel thirty feet in diameter, and, in the round numbers of Mr. Genet, ninety feet in circumference. The rope or chain, which is to draw up the boat, is to pass over a drum or drums, of twenty feet in diameter, or sixty in circumference; the large wheel is to drive a pinion on the drum shaft, and give to them fifteen revolutions for one of the large wheel so that the periphery of the drums will travel through 900 feet, whilst that of the large wheel travels 90, and of course, if the balloon be allowed to ascend 90 feet, it must draw the boat 900 feet. It is rather an inverted procedure in mechanics, to drive a pinion, by a wheel of fifteen times its size; but the object to be gained is very great indeed; no less than to cause a power of 3236 lbs. moving through a space of 90 feet, to raise 60 tons to the perpendicular height of sixty feet. According to the *exploded* philosophy, 80,000 lbs. or twenty-five times the amount assigned in the Memorial, would just balance the sixty tons. How mighty are the Upward forces.

For the mode of filling the ærostats, *instantly*, with the *coal gas*, Dr. Pascalis refers to the Memorial: anxious to learn how to do this, I carefully examined the work, but alas, it was in vain.

"*To propel boats on a high level destitute of water, and to lower them to a water level,*" is the next scheme; it is the child of the former and resembling it in so many of its features, may be dismissed in a few words. There are to be rail-ways, with balloons and buildings, fixed as before, for raising the boats to a summit level; other balloons are to be placed, with similar appurtenances, at suitable distances from each other, these, in their ascent, are to draw the boats along; after which, the balloons are to be successively "recalled down," that they may renew their labors.

"*To relieve steam boats stranded, or grounded.*" The boats are to be furnished with empty balloons, which are to be filled *instantly* of course, with "ignited air," *cooled by passing it through water*, and with *coal* gas; which gases, we are told, are, in general, dissipated without any advantage. Coal gas in the chimney of a steam engine! This is a discovery of Mr. Genet's, which his masters in chemistry and philosophy never dreamed of; they would have looked there for carbonic acid, and nitrogen, and would have expected to find but little else; and with these they never would have thought of filling ærostats, excepting to promote the art of sinking.

Passing over various applications of the same means, we come to the "*applications of the ærostatic and hydrostatic powers combined.*" Mr. Genet has performed some experiments, by means of an instrument, which he calls an *hydroaerostatometre;* a hollow tin vessel filled with air, and of the capacity of half a cubic foot. By the use of this instrument, he professes to have ascertained, that, using the old French standard, of 70 lbs. to the cubic foot of water, the *upward force* of the instrument, when immersed in water, was 100 lbs. for every cubic foot. Although this is 30 per cent. more than could be obtained by any other philosopher, we may let it pass, as this difference will add but little to the efficiency of his machines.

The *hydroaerostatometre*, gives birth to the *hydrostat*, which, in principle, is the same with the *ærostat*, substituting copper for silk, atmospheric air for hydrogen, (or for carbonic acid, and nitrogen,) and water for atmospheric air. The *hydrostat*, is, in fact, a copper vessel filled with air, and is to be used "*to raise*, or LOWER, *vertically, canal boats*, *to a* HIGH ALTITUDE." (Memorial, p. 39.) This copper vessel, is, in the example given, to be a spherical balloon of fifteen feet in diameter, and it is said, will contain 15,000 feet of air, and allowing the 30 per cent. before given in, and reckoning nothing for the weight of the copper, the chain, &c. is to be pressed by the upward force of water, with a power of 150,-000 lbs. or 75 tons. This copper ball is to be placed in a well into which water when wanted may be admitted. This well is to be 16 feet broad, and thirty feet deep; in this, the *hydrostat* is to be capable of rising to the height of ten feet, and by means of a rope or chain, like that of the *ærostat*, is to raise a canal boat, weighing seventy-five tons, to the height of *one hundred feet;* its power being increased ten fold, by causing a wheel to turn a pinion $\frac{1}{10}$ of its diameter. Comment and reasoning are here unnecessary, to those who would be capable of understanding them.

Passing over several applications of this *new* power, as they are mere variations of that just given, I proceed to the *hydronaut*, in which it is to be used as a substitute for the steam engine. It will be seen from the remarks of Mr. Genet in his 'reply,' that I had selected this as the pricipal object of notice, in the Franklin Journal, for January last. I beg leave to repeat a part of those observations, and to add a few others on the same subject; but first let us hear our author speak for himself. (Memorial, p. 62.) How can I procure the same alternate motion of the hydrostat? By immersing it alternately in two different fluids, air and water; but as a single hydrostat could not accomplish that object, and procure an alternate motion, rapid enough to perpetuate the rotatory motion, two must be employed; and by doing so, there will be no disparagement between the steam and the hydrostatic engine; since it is well known that it has been found necessary to introduce two cylinders in the steam engine, to perfect the rotatory motion, and replenish the deficiency of a single cylinder."

Mr. Genet, as usual, errs when speaking of the steam engine, it being "well known" that, although two cylinders have been sometimes used, it has *not* been found necessary to introduce them "to perfect the rotatory motion, and replenish the deficiency of a single cylinder;" and that they have been abandoned, in nearly every instance, excepting in the loco-motive carriage. This gentleman is perpetually haunted by the ghost of the atmospheric engine, and must in his *numerous observations*, have mistaken the air pump, for a second steam cylinder.

My reason for selecting the hydronaut as the object of my former animadversions, was, because, of the whole series of proposed machines, this is the most absurd. In the others, although totally inadequate to the production of the intended effects, there is a capacity for motion; but in this, there is no principle of motion, whatever; if there were, it would be, to all intents, a *perpetual motion*, in the ordinary acceptation of that term; it is to operate without the application of any extrinsic force; no fuel is to be expended, no springs to uncoil; no weights to descend; no animal power, wind or running water to be used; nothing in fine but the principle of alternate, *absolute levity*. The thing is simply to be suspended in air, and water; is there to commence running, and to "navigate until it is stopped." When a man undertakes to construct a perpetual motion, and at the same time thinks himself a philosopher, we must leave him to himself; and if it be thought worth while to treat the subject with any degree of seriousness, it is only for the sake of the confessed tyro.

For the description of this apparatus, as given by Mr. Genet, I must refer to the memorial, or to the plate and analysis of Dr. P. in your Journal. I have thus described it, in the article already referred to.

"The *proposed* moving power of the hydronaut, consists of two hollow copper vessels, called *hydrostats;* they are to be cylindrical, with conical ends, perfectly closed; these are to be suspended upon a beam, twenty four feet long, resembling that of a steam engine, and are to hang below it similar to a pair of scales upon their beam. These hydrostats, are to be contained within two cylinders, which stand under the beam, and in which they may freely rise and fall, when the beam vibrates. These cylinders are to be open at top, and to have a valve in the bottom of them, to open a communication with the water in the river; by some means, (what means we cannot discover,) water is to be made to flow, alternately, in and out of these cylinders; that which contains water, will have the *hydrostat* immersed within it, forced up by its buoyancy, that at the opposite end, being allowed to descend, in consequence of the removal of the water; and so on, *ad infinitum.* The machinery by which it is intended to remove the water, is to be worked by the same beam. This machinery consists principally, of two pumps oddly enough, called air pumps; their piston rods are attached to the beam, they being placed within the main cylinders; to the beam is also appended the apparatus for opening and shutting the valves; a piece fourteen feet in height, ascends from its centre, and from the end of this, a rod passes, which is to act upon a crank, and give motion to paddle wheels, whilst by the intervention of a *large wheel turning a pinion*, the velocity is to be increased. Should any one wish for a model of this machine, he may make it by suspending an egg shell, upon each end of a small scale beam, these will be his *hydrostats;* then by taking two glasses of water, and passing them alternately upwards against the shells, he will cause the beam to vibrate; and if he can then only contrive to attach to the beam, something which will relieve his hands from the task of moving the glasses, he will have contrived a perpetual motion, exactly upon the principle of that of Mr. Genet. Should he be at a loss to see how this is to be done, we must refer him to the inventor, as we cannot direct him even with the aid of the engraving, and the book. "So the *hydronaut* will navigate until it is stopped," say the gentlemen concerned; we however, feel inclined to transpose the sentence, and to say, "so the hydronaut will stop until it is navigated."

However ludicrous the machine may appear, as represented in the proposed model, Mr. Genet cannot deny that, so far as it goes, the picture is a correct one; and that it would be completed by first allowing the tumblers to stand in a vessel containing water, so that it might run on the outside of them, to the same height at which it stood within, or to the same height at which they would stand, were their bottoms perforated; and then causing the beam to work two pumps, and two valves, which should alternately exhaust the tumblers of their water, and alternately allow them to fill; the beam should do this perpetually, until it be forcibly stopped; it should also produce a large excess of power, which, in the actual machine, is to give "power superior to the effective and disposable force of any steam boat navigating the ocean." Mr. G. further says, that between this and the steam engine "there is no difference but simplicity and economy."

I have sir, with great pleasure, read your observations on ærostation, and coincide with you, in almost every instance.

I accord with you also in the spirit of your concluding remarks, but do not think that the case in hand is one to which it applies; I mean when you say "We conclude by wishing Mr. Genet ample success. Failure will involve no disgrace, but success would add another brilliant leaf to the book of discovery." Although I doubt the practicability of steering balloons in the air, I have not the temerity to say that it is impossible, and I would cheerfully aid and gladly witness, an experiment for the attainment of this object, provided the means indicated, were not palpably, inadequate. But were some person to propose to elevate an æronaut by the "specific levity" of carbonic acid, or to raise a load of seventy-five tons, to the height of one hundred feet, by the descent or ascent of a power of seventy-five tons, to the distance of 10 feet, I should be disgraced as a man of science, were I not to condemn the project in the most unqualified terms; and here also we undoubtedly agree.

"*The ærostatic vessel, or æronaut,*" appears to be Mr. Genet's greatest favorite. I cannot attempt to point out the numerous fallacies respecting it, which are contained in the memorial, but will merely make a few remarks upon the main point, the proposed means of propulsion; and even on this, I shall offer but a small number of objections which present themselves. Mr. Genet proposes to navigate his balloon by the power of two small horses, each equal to 100 lbs. making conjointly 200 lbs. In this estimate he has left out of view, that most important function of their power, velocity. His two small horses, would be able to draw the weight assigned, with a velocity of only two and a half miles per hour; yet with them he is to move sails, which according to his own calculation, are to "produce a pressure of 4200 lbs. *per minute* upon the air." Now according to the vulgar arithmetic, by which other philosophers have made their estimates, this would exceed the power of three horses, 20 fold; but Mr. Genet says, that their power "being multiplied by 21 revolutions of the air wheels in one minute will produce a pressure of 4200 lbs." The same principle prevails here, as in his other machines, power and speed, are both obtained, by making large wheels act upon small ones.

The small power which I have assigned, say $\frac{1}{20}$ of that claimed, will be reduced to less than nothing, by making a very moderate allowance for friction, and by the want of propelling power in the paddle wheels, a main feature in the apparatus. These wheels which are estimated to act upon the air with a force of 4200 lbs. per minute, are each furnished with sixteen wings, or fins, five feet in length, and two and a half in width. Eight of these on each side, are to act at once, the other eight being doubled up, within a case, or curb, to prevent their neutralizing those which are in action. Allowing it to be practicable to fold in these wings, without an immense loss of power, let your readers turn to the plate, and see what will be the action of the eight which remain; that is, what portion of their power will be employed in urging the balloon forward. It will be at once perceived that the wings which are first liberated, tend to drive the æronaut back, just as much as those below, tend to drive it forward, and that the only apparent effect, would be to elevate it, by the descent of those which are intermediate. I am a little surprised that this case or curb, was not placed upon the top; this certainly would have been an improvement, at least to the apparent power of propulsion, for although the thing would still have been nearly powerless, it would have looked as though it might possess power.

Before I close, I will offer another mode of estimating the power of the horses, founded upon data, given by Mr. Genet. A section of the æronaut, the car, the wheels, &c. would measure about 2500 square feet. A brisk breeze, according to the tables of the memorial, travels at the rate of about eleven miles per hour, and exerts a force of about eight ounces upon every square foot, this upon 2500 feet, would be 1250 lbs.; and this therefore is the force, which when a brisk breeze blows, tends to carry the balloon, eleven miles per hour. This is equal to the power of about 60 of Mr. Genet's horses; and were it not for the intervention of his wheels and pinions, it would be necessary to employ this number, at least, notwithstanding the bird-like form of his balloon.

But after all, may not the æronaut burst? The probability of this is confessed; but although, without freight, passengers, or additional horses, the articles taken up are estimated to weigh 13,400 lbs. Mr. Genet assures us that "the downfall would be as light as a feather," as he is confident that the whole would form an immense parachute. Should he err as widely in this estimate, as in those which have preceded it, the consequences might be very serious; and I for one, will not, if invited, consent to ascend, unless one of the horses be assigned to me, and he be of the Hypogryf breed.

ART. XV.—*Notice of an Introduction to Systematic and Physiological Botany; by* THOMAS NUTTALL, A. M., F. L. S. &c. 8vo. pp. 360. Cambridge: Hilliard & Brown.

(Communicated.)

THE present work forms a happy exception to those Introductory Treatises upon different subjects, which are the offspring of avarice, or of the pride of authorship.

That, certainly, is a false opinion, which supposes a mere knowledge of books is adequate to the production of a useful elementary work upon any science which relates to sensible objects; as we have sufficient evidence in various treatises upon different branches of Natural History. He, alone, who has arrived at a thorough and practical knowledge of a science, is capable of assisting others to attain eminence;—he it is, who understands all the difficulties which are to be encountered, and the way to overcome them, and all others, who have the temerity to make this attempt must fail. If a person whose knowledge of a science is derived from books alone, attempt a treatise upon it, for the assistance of beginners, what is his prospect of success? In treating of distinctive characters, by what means is he to decide upon their relative value? Experience has never taught him the fallacy of some, and the value of others. How shall he determine upon a judicious classification, when he does not know in what *individuality* consists, or what constitutes *affinity* among different individuals? and how will he acquit himself in that most difficult part of his subject—*physiography?* That a treatise, therefore, from such an author should be adapted to the wants of a tyro, is as little to be looked for, as that a man can teach what he never knew; and, indeed, this is the very absurdity that such an author proposes to himself, since he attempts to qualify others to recognise and classify objects, whose characters he, himself, has never learned. Books, of themselves, can never teach the sciences that relate to natural objects; practice and a familiarity with the objects themselves, can alone effect this. Such books, therefore, it is to be feared, instead of facilitating the progress of the student, will only tend to bewilder and disgust him: and that too, where there is no real difficulty.

It is not always the case, that, those who are the best qualified to furnish elementary treatises, possess the requisite self-denial to pause in their career, for the humble task of writing vade-mecums ; and accordingly, we are not always indebted to this class of authors for our Introductions. This consideration greatly enhances the pleasure we feel, in having put into our hands the book before us,—coming as it does, from one, whose rank among the first Botanists of the age is so conspicuous ; and we are persuaded, that its accomplished author will receive a rich reward for his labor, in that increased interest, which his work will create, in favour of the pursuit to which he has so long, and so successfully devoted himself.

The following remarks we extract from Mr. Nutall's preface.

"Nearly all the elementary works on Botany, extant, are derived from the *Philosophia Botanica* of Linnæus, a work of great labor and utility to those who would wish to make themselves masters of this fascinating branch of natural knowledge. Its technical character, however, often proves appalling to many who would willingly become acquainted with the characters of plants, did any easier route present itself. The first and most natural inquiry concerning plants, is the nature, and character of those beautiful objects, we call the flowers; these, by various interesting qualities, recommend themselves to every one. Their brilliant colors, beautiful forms, fragrant odors, and delightful association with the various seasons of the year, with the promise of fruits and of harvests, all combine to give them an importance, which no other part of the plant possesses. To indulge this shorter route to the knowledge of plants as a science, after the manner of Rosseau's delightful Letters on Botany, is the object of the present volume."

Contrary to the usual practice, Mr. N. does not commence with the nomenclature of Botany ; but proceeds, immediately, to the consideration of those more pleasing, as well as more important parts of plants, viz. their flowers: by means of which, we are enabled to distinguish them from each other, and to assign them their proper places in an arrangement. The first seven chapters are devoted to the description of those seven great classes of flowers, the Liliaceous, the Cruciform, the Papilionaceous, the Labiate, the Umbellate, the Compound, and the Rosaceous, which include by far the largest proportion of the vegetable creation. This suppression of the technical nomenclature of the less important parts of vegetables, from the student, at a period, when he cannot perceive its utility, is, undoubtedly, highly judicious; since, to use Mr. Nuttall's own words, " it has but too often deterred, at the very portal of Flora's temple, the inquirer into the nature and character of this beautiful and useful tribe of beings."

Next succeed two chapters upon the classes and orders of the *Linnæan system.* Concerning which the preface contains the following remarks.

" I must acknowledge, that however attractive the natural method of arranging plants may be to myself, I do not yet, for the beginner, know of any substitute for the Linnæan system: and, indeed, its general prevalence to the present time, after so long a trial, is almost a tacit acknowledgment of its convenience, if not of its superiority over other systems of arbitrary arrangements; for however natural, groups or orders of plants may be in their natural affinities, all classes and higher divisions of the vegetable system are now, confessedly artificial, even among the warmest advocates for a natural method."

Then follows an illustration of each one of the Linnæan classes and orders, by the description of specimens of American plants belonging to it. This forms the most considerable part of the work, occupying twenty chapters, and is introduced by the following passage.

" We come now to the determination of individual plants, which from classes and orders, descend to genera or kinds, and individuals or species; species are likewise subject to variations more or less constant, as we see in our fruit trees; for instance, in the apple, of which all the kinds we cultivate are mere varieties of one original species, called by Botanists, *Pyrus Malus*, the latter word indicating the name of the species, the former, or *Pyrus*, the genus or kind, and which also includes other species, as the *Pyrus communis*, or Pear, the Pyrus coronaria, or sweet scented crab of America, &c. This common generic character is applied to all such groups of plants, as, agreeing generally among themselves, present a similarity, not only in the class and order, or stamens and styles, but in the more intimate connexion of resemblance in the flower, and its succeeding fruit; so that while classes and orders are often merely artificial assemblages of plants, a genus always rests satisfied with bringing together such subordinate groups only, as are clearly natural; or, while they agree in the structure of flower and fruit, only differ specifically, in the minor consideration of the forms of leaves, petals, appendages, or slight modifications of parts. It cannot be denied, that, however anxious the systematic botanist may be to draw nice distinctions among kindred genera and species, yet when he proves so fortunate as to become acquainted with a perfect group of natural or resembling genera, and approximating species, he cannot often help observing such an interlinking, and gradual passage of one modification of form into another, as to lead to the belief that such divisions as genera and species, though generally convenient and lucid in arrangement, are often not really in the original plan of nature, which ever delights in slender shadows of distinction, and while uniting, yet contrives to vary with an infinite diversity, the tribes of her numerous kingdom." pp. 43, 44.

The second part of the work is devoted to the Physiology of Plants, and consists of five chapters: with the first of these, containing some very interesting remarks upon the *general character* of *plants*, we shall close our extracts.

"Besides the consideration of plants as mere objects of a system and holding a relation to each other, they deserve a higher regard as forming an eminent part of living and organized nature. Like animals, they are subjects of life and death, and only differ essentially from that higher order of beings in the want of evident sensibility; for the few apparent and equivocal exceptions to this universal rule, in the plants termed sensitive, do not militate against its general application. Nothing like nerves, or a nervous sensorium is to be found in the vegetable kingdom, and, consequently, no display of that motion, energy, or irritability, which belongs to the government of the different senses. The propulsion of the sap, derived alone from a fluid papulum, and its elaboration, in the vegetable tissue, into which it immediately enters, appears at once the simple source and cause, of all that inappreciable motion in this tribe of beings, which we term growth or developement.

"The display of vegetable vitality, is, in many instances, periodical. In those plants which we indefinitely term annuals, the whole period of existence terminates in a few months, and from the seed alone, is then to be obtained a new generation of the species. But in our perennial plants, trees and shrubs, which often die to the ground, or cast off their leaves at the approach of winter, though, the motion of the sap is arrested by the influence of the cold, and the generation of the year perishes; yet besides the seed, nature has here provided an ample source of regeneration in the innumerable buds, formed or ingrafted in the alburnum or sap-wood of the root or stem; by this means, at an early season of the year, an invariable supply of vegetable beings are as plentifully produced, as required by nature. The buds of each tree or plant, containing within themselves individually, all the rudiments of so many distinct vegetables, may be transferred by ingraftment or growth in the earth, and thus form as many distinct individuals, each again subject, *ad infinitum*, to produce an additional ingrafted progeny of buds and branches. The numerous buds of each tree, nourished through the common medium of the trunk and branches, perish after developement and maturity, and are succeeded anew by another generation of ingrafting or protracting buds, for which they have provided by the deposition of the alburnum. The growth of every tree, as well as herb, is then strictly annual; and the trunk is produced by a curious junction of dead and living matter. The rings of wood, which may be counted in the transverse section of a tree, not merely indicate its age, but the number of *distinct* generations of spontaneous ingrafted individuals, which it has sustained. In the annual kingdom, among the order Moluscae, examples of this kind of aggregation are not uncommon, where many animals are inseparably connected, and nourished through a common medium. This agamous race of plants are always similar to the parent from whence they have originated, as we all know by the process of budding and ingrafting; that these buds or grafts partake of the age and accidents of the trunk on which they are evolved, is improbable, if not impossible, as they can in fact be influenced only by the stock to which they are last transferred.

"But the most obvious display of vitality in the vegetable kingdom is the generation of a new race from sexual intercourse, consequent on which, the seed is produced; in fact, an ovum like that of the birds and insects, containing a *punctum saliens* awaking to life on the congenial addition of the requisite heat and moisture. This progeny of the flowers, though specifically similar with the parent, is yet often subject to considerable variation, as in the races of the animal kingdom.

"The infant plant, is for a while nourished with a ready formed supply of nutriment contained in the mass of the seed, or in the infant leaves, (*cotyledons*,) which it first produces. The vortex of vitality, influenced more or less by external causes is now destined to continue its operation as long as the plant happens to live; (for the death in the vegetable kingdom, which we see take place in a tree or a shrub, is ever the effect of accident, as we have already remarked, that no race of vegetable beings continues to live for more than a year.)

"Plants, like animals, consist of fluids and solids. The sap, almost similar to the venous blood in its functions, is commonly imbibed from the bosom of the earth by means of the fibers of the root. When it first enters, its composition is very simple; it is propelled upwards by a system of tubes or vessels, but is not prepared or elaborated by any thing like a stomach, as in animals; the fibres of the root perform this selective office: but so involuntarily, that poisons to the vegetable structure, if present, are almost as readily absorbed as matters of nourishment. The sap at length conveyed into the leaves and green twigs is then exposed to the action of the light and the air, admitted by vertical pores, as in the lungs or gills of animals; and here in its descending course, it becomes prepared to supply all the solids and other peculiar products which characterize each peculiar species of vegetable.

"The constitutions of plants are more variable, than those of animals; so that they are fitted, in great variety, to occupy the whole surface of the earth. The arctic regions have their peculiar tribes of plants, as well as the luxurious region of the tropics, where frost is unknown. At one extremity of the earth, or on the snowy summits of the loftiest mountains, vegetation only actively lives about two months in the year; in this short period the dwarf productions of this region of ice, flower and perfect their seed, or prepare a new generation of buds, and then again fall into a state of dormancy, and commonly remain buried beneath their congenial snows. Within the tropics, a region which may truly be termed the paradise of plants, the utmost variety prevails. Within the compass of a few leagues, thousands of species may be enumerated; while the whole Flora of Spitzbergen contains only about thirty species, and all of these dwarf herbs. In the tropics, trees and shrubs are almost as numerous in species as herbs.

The trees attain the most gigantic magnitude, and the forests filled with evergreens, are nearly impervious to the rays of the vertical sun; here the vegetables continue throughout the year in a state of active growth; dormancy in many of these plants would be instant death; the stream of vitality continues without interruption, and cold, before it attains the freezing temperature, is capable of destroying the tender vegetables of this favored region. These plants, however, by their inherent and constitutional temperament, are enabled to resist, like animals, the destructive and drying effects of the great heats to which they are exposed. So, also, the trees and shrubs of cold climates retain the necessary moisture of their vitality at temperatures, when other liquids would freeze.

"The presence of organic life, inherited from preceding individuals or parents of the same species, and only continued for a very limited period, under the condition of a vital movement of certain assimilating fluids, like the circulation of the blood of animals, is a character common to all vegetables. They have also an inherent constitution varying with the climate and the soils they occupy. These are stimulated passively by light, heat, and the ingredients of the soil. Their abundance appears to be infinite; and created principally for the subsistence of animals: their destruction as well as growth, is interminable. But though living they are formed without sensibility, and without sentiment; they have neither nerves nor senses, wants nor pains, that are capable of any perceptible expression. In the absence of nutriment they perish, with it they thrive; but show no more appearance of attachment to existence, nor resistance to that which causes its destruction, than the crystal of salt does to the contiguous agent, which effects its solution or decomposition." pp. 219, 223.

In this part of his undertaking the author acknowledges himself indebted to the very elaborate work on vegetable physiology, by Mr. Anthony Todd Thompson, published in London: and although the sketch he has given is necessarily very limited, we doubt not it will be perused with interest, not only by persons to whom the subject is new, but also by more advanced students. The work concludes by a glossary of such important terms as have not been explained in the progress of the work. It is accompanied by twelve very beautiful Lithographic engravings; and its entire execution is characterized by that neatness and precision, for which its publishers are so justly distinguished.

In conclusion, we would only remark, that it has fully answered the expectations we had formed of it, from a knowledge of the high attainments of its author, and that, in our opinion, it constitutes by far the most valuable treatise that can be put into the hands of a person just commencing this delightful study. To those who are acquainted with Mr. Nuttall's former productions, it need not be mentioned, that his style is simple, condensed and highly perspicuous; precisely what a style ought to be in all works of a similar nature.

Art. XVI.—*Volcanos.*

Among the physical phenomena of our planet, none arrest the attention of its inhabitants more forcibly, than those connected with earthquakes and volcanos. These tremendous displays of power cannot fail to interest even barbarous nations, who consider volcanic craters as the residence of demons, and their eruptions as the demonstrations of their anger, and as the means employed by them to spread destruction. The Missionaries in Owyhee, (Hawaii,) have given us, (see Ellis' Tour and the analysis of it, Vol. XI. p. 1, of this Journal,) a very interesting account of the Goddess Pele, and of the highly poetical mythology, which the natives have built upon her supposed dominion.

It is not surprising, that such terrific appearances should be imputed by barbarians to the agency of a local deity, and that the visitations of earthquakes and volcanos, should be regarded as malignant and vindictive inflictions.

Much of the poetical machinery of the Greeks and Romans was fabricated out of physical phenomena. The struggles of the Titans, buried beneath the mountains, by the anger of the Gods, were assigned by poetry, as the causes of the earthquakes of Italy, and Vulcan and the Cyclops, according to the annals of fable, forged their thunder bolts in the bowels of Etna and of the neighboring Lipari Islands.

But in modern times, since the exact sciences have received so much attention, volcanos have been studied with a philosophical spirit. Sir William Hamilton, Spallanzani, Ordinaire, Brieslak, Brocchi, Humbolt, Von Buch, Beudant, Mackenzie, Monticelli, De la Torre, Bory St. Vincent, Webster, Scrope, Daubeny and others have given us accurate statements of facts, and have reasoned upon them with direct reference to the present state of physical science.

To Mr. Scrope and Professor Daubeny we are particularly indebted, for recent and very valuable observations and discussions. Mr. Scrope published in 1825 his "Considerations on Volcanos," and last year his "Memoir on the Geology of Central France." Professor Daubeny has also very recently published his "Description of active and extinct Volcanos."

All these works are of great value, and as they have not been republished in this country, and are probably possessed by very few persons among us, it is our wish to make our readers acquainted with their character, which will be best done, by giving some account of their leading features.

Other engagements prevented us from doing this a year since, with respect to the "Considerations on Volcanos," of which we early received a copy from the author, and if we now adopt the analysis of an Edinburgh Journal,* it is because we cannot present a better view of the work—a view remarkable for its candor, its accuracy and completeness. Some things may perhaps also be drawn from the "Journal of the Royal Institution,"† and should there be occasion, we may add some remarks of our own.

It is our wish also, to present at a future time, some account of Mr. Scrope's work on the extinct volcanos of France, &c. and of Professor Daubeny's Lectures on Volcanos, but the length of the present article will necessarily exclude a notice of them from the present number.

As this Journal has consisted, almost exclusively of original American productions, we trust that the extensive quotations which we shall now have occasion to make, will not be considered as a deviation from our plan, and that the high interest and importance of the subject will prove a full justification for occupying with it so much space, and for the postponement of some original articles.

While we entertain and express the highest respect for the authors of the works alluded to above, we wish to be understood, to attach the principal value to their precise, methodized, and copious statements of facts; with most of their conclusions we do indeed, fully agree, but there are theoretical

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* Dr. Brewster's Journal for April 1826. Vol. IV. p. 334.

† For Jan. 1826, Vol. XX. p. 356.

points in these discussions, which will probably never be settled, and about which there will continue to be a diversity of opinion.

Analysis of the

CONSIDERATIONS ON VOLCANOS, BY G. POULETT SCROPE, ESQ.

Sec. Geol. Soc.

"Describing generally what is meant by volcano, and by lava, in which the author properly includes all volcanic rocky erupted matter, under whatever form it may be disposed on the surface, Mr. S. proceeds to state the known volcanos at 200; afterwards showing reason to think this to be much less than the number probably existing in the world. The arguments for this opinion consist in our ignorance of the interior of great continents, in the probability of unknown marine volcanos, and in the fact that, for want of observers and records, many which have broken out at distant times, are unknown or forgotten.

"To the terrestial volcanos he has given the term subaërial, and to the marine the appellation of subaqueous.

"In the first class, the character of the appearances varies according to the incidental fact of the volcano being new or appearing through an ancient vent. But it is not very certain that we know of any rigidly new; as even the eruptions of Yorullo are considered as coming from vents subsidiary to former ones. Auvergne, however, and the well-known country connected with it, in this respect, as well as the volcanic territory of the Rhine, preserve the records of volcanos which have been once of this character, and where therefore the circumstances can be studied with facility.

"With respect to the other case, the author proceeds to investigate the phenomena of active volcanos, dividing them into three classes, which he calls phase of permanent eruption, phase of moderate activity, and phase of prolonged intermittences.

"In the first class Stromboli is an unquestioned example; and the same appears true of the volcano in the Lake of Nicaragua. The second class includes the great mass of volcanos known as such; and among those, Vesuvius and Ætna are the most familiar and the best studied, from the free and frequent access which they have permitted for so many years, to persons endowed with the capacity for observation. This is also the character of the volcanos of the Pacific, of those of Kamtschatka, and the Molucca and Phillippine Islands, and indeed generally of many more whose histories are to be found without end in works, and of which the enumeration here would be too long for our analysis.

"In the third class, or under the phase of prolonged intermittences, the number is even greater than in the preceding; and as novelty, in the case of eruptions of this nature, is added to the naturally terrific circumstances attending them, these are the eruptions which have excited the greatest attention, and which make the greatest figure in history. The author proceeds to sketch the general appearances attending an eruption of this nature.

"They are commonly preceded by earthquakes of different degrees of intensity and duration, and with loud sounds or detonations resembling the noise of ordnance and musketry, apparently produced by the disengagement of aëriform fluids, and the increase of bulk in the fluid rocks; and their sounds are conveyed through the solid earth, not by means of the air. The atmosphere at this time is remarked to be in a peculiar state of stillness, attended by a sense of oppression.

"During this period also, springs are apt to disappear, so that wells become dry; and it is known that the extent of this affection is sometimes very considerable.

"When the eruption first appears, it is generally with sudden and great violence. Explosions, apparently from confined air, take place with loud noises, and succeeding each other with rapidity, and often with increasing force; the vent being, commonly, the central point or crater of the mountain. And in its attempt to escape, this air throws up fragments of rock, which sometimes fall back into the crater, and are again repeatedly projected, together with clouds of aqueous vapor. And as the fragments also are often broken into small pieces, and even into dust, this, uniting to the vapor or mixing with it, produces dense black clouds, or smoke, often assuming the form of a column of entangled or successively formed clouds.

"Having arrived at a certain height, this column generally spreads laterally or horizontally, forming, if the air is calm, a shape resembling that of a pine-tree, of if there be wind, a horizontal stream. Out of this cloud proceed lightnings of great vividness, while the falling of the dust, added to the density of the cloud, produces darkness over the surrounding country. The melted rock or lava now boils up in the crater, and is often so thrown up into jets by the extricated air, as to resemble flames; and at length it either boils over the edge of the crater, so as to run down the mountain, or else finds an issue laterally, by some crevice, equally flowing down in a stream, which holds its course as circumstances permit, down to the lower grounds.

"In the night this current is luminous; but in the day, it is generally obscured by vapors, or loses its light by the cooling and blackening of the surface. There are cases, however, in which no torrent of lava occurs, and where no other rocks than scoriæ are erupted. The greatest period of violence is generally over when the lava has flowed for a little while, or this is the crisis of the volcano. But commonly, the explosions of fragments and dust continue for some time, gradually diminishing, till the whole falls into a state of quiescence, and is finally extinguished. Lastly, it must be noticed, that from the action of the volcano on the atmosphere, clouds are generally formed in it, which produce falls of rain, often causing torrents, or even inundations.

"We must refer to the work itself, pp. 13, 14, for a catalogue of eruptions which we could not conveniently introduce. But the intervals of repose are various, reaching in some cases as far as to many centuries; so that cultivation and population are renewed, to be dispersed again at some future day. In these intervals of repose, however, it is common for vapors to continue to be produced, either from the craters, or in the course of the currents of lava; and when these are sulphureous, they deposit sulphur; and in other cases, from their acid nature, they corrode and decompose the rocks through which they find a vent. What are called solfataras and souffrières are the result."

Journal of Science of the R. Inst. No. 40, *p.* 356.

The above citation contains a concise, but clear and interesting account, of the principal phenomena which attend volcanic eruptions. We now proceed to quote the Edinburgh Analysis.

"The work of which we propose at present to give a copious analysis, is one of those excellent productions which appear at very distant intervals, and give a new tone to scientific inquiry. Mr. Poulett Scrope has not only enjoyed numerous opportunities of studying many of the grand operations which he describes, but he has exercised unusual diligence in making himself acquainted with the facts and reasonings of our most eminent geological travellers. When we say, that this work was written after visiting the active volcanos of Ætna, Vesuvius, and Stromboli, and exploring the extinct craters of Auvergne, of Italy, of the Rhine, and of the north of Germany, we offer our readers some pledge for the accuracy of its facts, and the soundness of its reasonings.

"The work commences with a descriptive account of the Volcanic Phenomena, in which the author treats of the number and dispersion of volcanic vents on the surface of the globe, a detailed catalogue of which is given in an appendix. The number already known is supposed very much within that which really exists, for many reasons, but particularly because the intervals of rest between eruptions are often of such long duration that the former activity of the vent is unrecorded, and again because it is probable that numerous vents exist under the sea, whose activity however frequent, cannot be made known to us till the peak of the volcano rises to within a short distance of the surface. Volcanic phenomena are classed into *subaerial*, or those which take place in the open air, and *subaqueous*. Of the former class, which is more open to study than the latter, some take place from *new*, others from *habitual* vents. The last are most common, and most accessible to observation. The condition of all habitual volcanos, or sources of erupted matter, appears to belong to one or other of the three following phases:

"1. In which the eruption is permanent (as in Stromboli, &c.)

"2. In which eruptions are frequent, prolonged, and of moderate violence, and the intervals of repose short.

"3. In which intense eruptive paroxysms, of brief duration, alternate with lengthened intervals of quiescence.

"These phases are separately considered, and examples given of the phenomena of each, as well as a particular description of all the remarkable circumstances which accompany and characterize a volcanic paroxysmal eruption, and which appear to the author to present so great an uniformity in all places, and at all times, as to warrant the conclusion that the main phenomena are invariably the same; 'no farther discrepancies existing, than what are fairly referable to the modifications produced by local accidents, or by differences in the intensity of volcanic force developed, and in the mineral quality of the erupted substances.'"

Stromboli appears to have been in ceaseless activity for at least twenty centuries, throwing out, not flames nor lava, but scoriæ. It is most violent before and during stormy weather, especially in winter, when lava is said to burst occasionally from its side into the sea, heating it to such a degree as to boil the fish, which are cast on shore ready cooked.

This volcano is viewed by the fishermen as a weather glass, by which they auger the approach of tempests.

The volcano in the Island of Nicaragua, called, by the sailors, the Devil's Mouth, is said to be constantly active, and this appears to be nearly the case also, with that of Kirauea in the Island of Owyhee, (Hawaii,) but these instances are very rare.

Many volcanos are in a state of moderate activity, with occsional paroxysms. Vesuvius was in this condition from the beginning of the present century to October 1822, when there was a violent eruption. A similar state of things existed from 1767 to 1779, when a violent eruption gave vent to the force, and the volcano became inactive till 1803 a period of twenty-four years.

Ætna was eruptive with intermediate agitations in 1805–9–11–12 and 19, but both these volcanos have had periods of long repose, even for centuries.

Popocatepetl, in Mexico, has been active ever since the conquest of Mexico, and that of Sangay in Quito, has been in incessant activity for about one hundred years.

Mr. Scrope mentions as instances of remarkable volcanic paroxysms, those of Vesuvius A. D. 79, 203, 472, 512, 685, 993, 1036, 1139, 1306, 1631, 1760, 1794, and 1822.

Ætna, in 1169, 1329, 1535, this latter eruption lasted two years "with terrific violence," and occurred after a quiescence of nearly one hundred years.

Teneriffe, in 1704, 1797–8.

San Georgio, one of the Azores, in 1808.

Palma, one of the Canaries, in 1558, 1646, and 1677.

Lancerote, one of the Jame group, in 1730.

Kattlagia Jokul, in Iceland, in 1755, which lasted a year.

Skaptar Jokuhl, in 1783.

Violent eruptions are generally succeeded by periods of long repose, sometimes extending even to centuries. Decomposed lava forms a soil even in the crater, and vegetation springs up.

"All appearances of igneous action are effaced; forests grow up and decay, and cultivation is carried on upon a surface, destined, perhaps, to be blown to atoms, and scattered to the winds, when the crisis arrives for the renewal of the volcanic phenomena. Thus during the quiescent interval, between the eruptions of 1139 and 1306, the whole surface of Vesuvius was in cultivation, and pools of water and chesnut groves occupied the sides and bottom of the crater; as is at present the case with so many of the craters of Ætna, Auvergne, the Vivarais, &c.

"Terrific eruptions occasionally break out from mountains not previously suspected to be of a volcanic nature, or in which the accounts, of former catastrophes of this sort, existed but as vague traditionary fables.

"In Chap. II. the immediate causes of these phenomena are investigated; and it is observed, that all their circumstances, as well as the direct observations of the author himself, Spallanzani and others, go to prove the existence, *beneath* every volcanic vent, of a mass of lava, or crystalline rock in a state of actual ebullition; the generation, or expansion, of electric fluids within its interior producing intumescence and elevation, and the explosions which take place from its surface. The nature of this elastic fluid has been ascertained by direct experiment, and it appears to consist almost wholly of aqueous vapor or *steam.* The uniform dissemination of air-vesicles through many lavas proves the vapor to have been generated throughout every part of their mass. We must then suppose the existence of water in combination with the other elements of the rock. This leads to an examination of the nature of lavas; and the author finds reason to conclude, that the crystalline particles of which they are composed were not formed as the substance cooled; that few or no lavas are ever reduced naturally to complete *fusion* (none in fact but the glassy lavas, obsidian, pearlstone, &c.;) but that they consist of crystalline particles of various sizes, which, when the rock is solid, contain very minute portions of water mechanically combined with their substance,* that is, intervening between the parallel plane surfaces of the crystals. In this case, any continued accession of caloric to a mass of such rock confined beneath the crust of the earth, and already at an intense temperature, must sooner or later so increase the expansive force of the confined water, as to reduce more or less of it to vapor, breaking through or heaving upwards the confining crust, and causing the lava to intumesce and rise outwardly in a state of imperfect liquefaction through any fractures which the violent expansive effort may create in the overlying beds. The liquidity of lava consists, under this idea, not in its alsolute fusion, but in the mobility afforded to its compotent

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* This at least is the temporary assumption of the author, who in a later part of the work, observes, that he inclines to suppose the water itself may be generated, together with other fluids, by the volatilization of a superficial pellicle of the proximate crystals and the combination of the oxygen and hydrogen set free by this process, through the intense temperature pervading the mass. Such a supposition, if not supported, is perhaps not opposed by the present state of chemical knowledge; and would explain all the phenomena of lavas, as well as the idea of a mechanical interposition. In short, the existence and general dissemination of water, or rather steam, in lavas, is a positive fact susceptible of direct and incontrovertible proof; and it is indifferent to the purpose of the author how, or at what time, we suppose it to be produced there.

crystals by the intervention of more or less of highly elastic vapor between the opposite facets, and the degree of liquidity will therefore depend on the quantity of vapor generated through the substance, and the *size* of the component crystals. But at a certain term in the relative proportion of these circumstances, the vapor will become so abundant as to enable a part of it to unite into bubbles, which, by their inferior specific gravity, are urged to rise upwards, and escape from the surface of the liquified mass in which they are formed. "The quantity of vapor discharged in this manner consists therefore at all times of the surplus of that which has been generated in the lava beyond what is necessary to communicate to its component crystals the degree of mobility required for the union of this surplus vapor into parcels or bubbles, and the rise of these, when formed, to the surface." The explosions of all volcanic eruptions are produced by the rapid ascent and escape of such bubbles, collecting as they rise through the lava into prodigious volumes of vapor; and the remainder of these parcels of vapour, which are prevented from thus escaping by the superficial induration of the exposed masses of lava, occasions the cellular and cavernous structure of such rocks both on the large and small scale. The consolidation of liquified lava, under these circumstances, takes place, not only by the loss of temperature, but also, and chiefly, by the immediate escape of the vapor (which alone occasions the mobility of the crystals) on their superficial exposure to the outward air; subsequently, by exudation through the pores or interstices of that hardened surface, the process is propagated to the interior of the bed of lava. Consolidation may also take place by increase of pressure on the bed of lava, without any change in its temperature; the vapor being condensed till the crystals reunite, more or less conformably, according as they have been more or less broken up, or *disintegrated*, by mutual friction, when in motion, and by the disaggregative force of vapor generated within them.

"Having developed these original ideas as to the nature of lava, which are supported by facts and arguments, the author goes on to explain all the phenomena of earthquakes and volcanos, and the circumstances of disposition, structure, and mineral character in volcanic rocks, by the assumption, which, however, is strongly supported by a large body of evidence, that the interior of the globe, at no great depth from the surface, consists of a mass of crystalline rock at an immense temperature; and therefore, that a continual supply of caloric passes off from the centre towards the circumference, wherever the nature of the superficial rocks allows of its transmission, or temporary vents are opened for its more free escape.

"Where the superficial rocks, from their constitution, (as is presumed to be the case with the schitose strata, the limestones and sandstones,—or, when consisting of unstratified crystalline rocks, from the intumescence and refrigeration they have undergone,) are very inferior conductors of caloric, the heat transmitted from below will be concentrated in the beds of denser crystalline rock beneath these, and continually augment their temperature, and with it their expansive force. The overlying rocks will sooner or later necessarily yield to this force. At this time the expansive force will be greatest in the lower parts of the crystalline bed. The upper will be therefore raised *en masse*, in a solid state. This forcible elevation must be accompanied by the rupture and dislocation of the overlying rocks; and every such fracture in the earth's crust, must create a jarring shock and vibratory motion in them, which will be propagated along the prolongation of each rocky bed, with an intensity proportionate to its solidity; the strata which are only in contact with those broken through, sharing in the vibration in an inferior degree. These shocks are earthquakes, none of which are supposed to take place without a certain though often inappreciable elevation of the surface of the globe. The fissures formed in this manner will be more or less wedge shaped; some opening outwardly, some downwards. The latter allow of the sudden expansion and liquefaction of the intensely heated rock in which they are formed, and by this process the fissure is filled with intumescent lava. Where the fissures are broken through, the upper beds of heated crystalline rock, *contemporaneous* veins, or subordinate masses are produced, where, through overlying strata of other characters, *injected* veins or dikes. The friction occasioned by the resistance of the sides of the cleft to the rise of the crystalline matter partially disintegrates the crystals, and gives a finer grain to the substance of the vein than that of the including rock; and also often occasions the crystals composing the lateral parts of the vein to be more comminuted than those in the centre. The matter filling these veins is immediately consolidated both by the loss of temperature and pressure, and the fractured rocks are thus repaired and strengthened. An interval of tranquillity will then succeed, until a similar expansion occurs. It is thus that the overlying rocks which form the surface of the globe must be progressively elevated more and more, by the successive dilations of the interior lava-bed unless some avenues are opened within a limited distance, for the more tranquil escape of the subterranean caloric.

"But the formation of such apertures (*volcanic spiracles*) must sooner or later result from the continuance of this process; for at every crisis of expansion, those cracks are only repaired by the injection and consolidation of lava, which open downwards. Others which increase in width towards their upper extremity, will remain open, and effectually weaken that part of the crust of rocks across which they are broken. Subsequent expansions, taking effect most powerfully on these weak points, will widen and extend these fissures until some one is sufficiently deep and broad to permit the lava in the lower parts of the fissure to rise by its intumescence into communication with the atmosphere on one or more points at the upper extremity, thus producing a volcanic vent or vents.

"In most instances, the fissure must be narrow, irregular, and intricate, and the distance great from the external surface to the focus of ebullition. The intumescence will be proportionately slow, and the repressive force, consisting of the weight of the rising column of lava, and the accumulation of fragments broken from the sides of the fissure, may stifle the ebullition before the lava has reached the lips of the orifice. Such may be called an abortive eruption, vapor alone escaping outwardly before the fissure is closed. The author attributes the clouds of smoke or vapor, and projections of fragments that have been discharged during violent earthquakes from crevices in the soil to a subterranean effervescence of this nature.* But where the width of the fissure, and other circumstances permit it, the lava reaches the mouth of the vent, and a regular volcanic eruption occurs.

"The author proceeds to examine the laws which regulate the developement of the eruptive force. This is opposed by the repressive force, consisting of,

"1. The supported column of liquid lava;

"2. The reaction of the vapor generated from the impediments to its expansion;

"3. The external pressure on the surface of the intumescent lava.

"Of these elements, the last is the most subject to variation, particularly from changes, 1. In the dimensions of the vent; and 2d. In the quantity and weight of matter pressing on the surface of the lava within the vent. 1. The violent rise and explosive

* It appears that the aqueous vapor emitted from fissures in the surface soil, during earthquakes is in general very great; since Ferrara mentions that extraordinary storms of rain immediately follow the occurrence of these phenomena. In the violent earthquake which affected the whole northern coast of Sicily in 1823, a remarkable dense black cloud collected over the district affected, and shortly was condensed into terriffc deluges of rain. The same thing happened during the great earthquake of Catania in 1693, and that of Calabria in 1783.

escape of the elastic fluids must at first break up and enlarge the fissure, and consequently, the energy of the eruption will progressively increase from its commencement; but, 2d, the weight and consolidation of the lava, protruded from the orifice, and above all, the immense accumulation of fragmentary ejections within and around the vent, must, before long, give the predominance, (unless under extraordinary circumstances,) to the force of repression; the crisis of the eruption is past, its violence diminishes progressively, and it is at length wholly checked. Hence, a general law is deduced, that the developement of volcanic action universally tends to its own extinction by augmenting the opposite force of repression.

The author then considers the condition at this time of the dilated mass of lava below, or the focus. Its temperature has been suddenly lowered below that of the surrounding crystalline mass—it therefore abstracts caloric from thence. If this accession of caloric keeps pace exactly with the increase of the repressive force, the eruption is permanent. If not, the continual increase of the expansive force in the lower parts of the crystalline bed, resolidifies the upper parts, and seals up the vent.

"But the expansive force of the focus continues to increase, and, perhaps, at length overcomes the resistance opposed to it. If it break out repeatedly in the same direction, it produces an *habitual volcano*, and finally a *volcanic mountain*.

"If the repressive force prevail till the focus is equalized in temperature to the stratum in which it lies, it shares in the general expansive force of that stratum. This is continually increasing, and must at length find a vent, generally on the same spot as before, and hence the frequency of habitual volcanos. If on a fresh point, probably on the continuation of the original fissure, the rocks having been shattered along that line by the earlier shocks; hence the linear trains of volcanic vents so often noticed. The distance of the new from the former vent, must depend on local circumstances in the structure, tenacity, and other elements of resistance in the overlying rocks. In this manner, the draught of caloric, passing from the great reservoir below to the exterior of the globe, is shifted from one vent to another; the focus of each active volcano, abstracting caloric from its inclosing walls; neighbouring vents will also more or less retard the activity of each other; and the extreme energy of one may cause the absolute *extinction* of the other. Other more tranquil modes of escape for subterranean caloric are found by the author in thermal springs, which result from the condensation of aqueous vapor percolating through minor crevices from the subterranean heated lava-rock. So long as by these, or other modes, the caloric passes off in the ratio in which it is received from below, the *general* expansive force remains invariable. If not, this force increases, and must at length prevail over the united forces of repression, and produce elevations of the superficial strata, earthquakes, &c. The author thus distinguishes between the general or *primary*, and the local or *secondary* expansive forces, each having their peculiar force: the first residing in the general subterranean bed of heated rock; the second in minor and less deeply seated foci. The laws thus determined hold good, whatever the scale of magnitude of the phenomena they give rise to, whether the elevation of a few square yards of rock, or of a whole continent; a quiescent interval of a few hours, or of centuries.

"Every habitual volcano acts, therefore, as a *safety-valve* to the globe, the caloric which emanates from its interior passing off by means of this vent into outer space. But these eruptions are necessarily accompanied by circumstances tending to impede their continuance, and they are thus, in the generality of cases, rendered intermittent. Where the opposing forces of expansion and repression are in equilibrio, the volcano is in the first of the phases noticed above. Where they oscillate frequently about an equilibrium, in the second. Where the oscillations are on a large scale, in the third. The first must necessarily be very rare. In the instance of Stromboli, our author attributes the permanence of its eruption solely to the peculiar form of the crater; the aperture of the volcano having a high and sloping ridge only on one side; on the other a precipitous slope down to the sea, which is there unfathomable. Owing to this remarkable figure, less than one half of the scoriæ projected from the aperture at each explosion fall again into it, and, consequently, there can be no accumulation of fragments on the surface of the lava within the vent, which always remains level, or nearly so, with the mouth of this aperture, without being discharged otherwise than in fragments tossed up by the bubbles of vapor which escape from it. The volcano of Bourbon again, a similar example of almost continual eruption, is shown by the author to owe this character to another peculiarity of form. This volcanic mountain is a complete obtuse cone, and there exists at the apex an almost permanent source of a very fluid and glassy lava, which slowly boils over the lips of the circular orifice, and flows rapidly on all sides down the steep slopes of the cone. Thus, in this, as in the former instance, the force of repression remains fixed, and that of expansion being always slightly in excess, the eruption is permanent. Where, however, these forces are so nearly in equilibrio, a very slight addition to that of repression may stop the eruption for a certain time, and Mr. P. S. supposes that even changes in the density of the atmosphere will occasionally produce this effect; and that a permanently active volcano, whose phenomena are, according to him, occasioned by the ebullition of water in the focal lava, from constant and uniform additions of caloric to it, will be as sensible as the barometer to variations in the pressure of the atmosphere on the surface of the supported column of lava; the ebullition ceasing for a few minutes or hours as the density of the atmosphere increases, and increasing in energy as it is diminished. Observation confirms this opinion. Stromboli is made use of as a weather-glass, and securely relied on by the fishermen of the Lipari isles; other volcanos likewise have been observed to augment their activity in tempestuous weather, and, in general, to be most violent in the stormy season of the year. Earthquakes also have been often observed to coincide in time with hurricanes or violent storms; and the author notices the probability that a diminution of the pressure of the atmosphere, taking place simultaneously on a large extent of the surface, beneath which the ever-active force of expansion is continually pressing upwards, and often restrained by only the slightest degree of superiority in the combined forces of repression, may occasionally give the predominance to the former force, and determine one of those partial elevations of the crust of the globe to which he attributes the phenomena of earthquakes.

"It is remarked, that an individual volcano may occasionally pass from one of the phases, distinguished above, into another; or may even exist in two phases at once, having a double system of operations, corresponding to two different foci, seated one below the other; the latter perhaps at a considerable elevation in the chimney or main vent of the volcano, and giving rise to minor and frequent eruptions; the former at a much greater depth, and productive of rare and violent *paroxysmal* eruptions. It is obvious that the last system must be in activity wherever the supply of caloric is in a faster ratio than its drain through the activity of the upper focus. The paroxysmal eruptions leave usually a prodigiously wide and deep crater, which is subsequently filled up by degrees by the eruptions of the minor and upper focus. Such alternations of minor and paroxysmal eruptions appear to have produced the colossal crateral cavities of volcanic countries, most of which have one or more recent cones rising from within their circuit, such as Vesuvius within the crater of Somma: the Peak of Teneriffe, and the cone of Chahorra, from the circus described by Von Buch; that of Bourbon from the successive circuses described by St. Vincent; those of Volcano, Astroni, the lake of Roneiglione, &c. &c."

The views of the author respecting the mode in which the crystals of volcanic substances are supposed to be brought into a state of fluidity, more or less perfect, are somewhat novel. If we understand him, the process is not exactly mechanical or chemical, and yet more of the former than of the latter, since the laminæ are supposed to be split asunder, so as to become inconceivably divided. Still we would take leave to ask, are the portions, however minute they may be supposed to be, chemically united to the steam, dissolved in it, or, are they mechanically suspended in an atmosphere of that hot aerial agent: or, under such circumstances, does the distinction between chemical and mechanical suspension become evanescent?—We are aware that the author speaks of the process as being mechanical, but perhaps there is nothing with which we are acquainted that is exactly analogous.

Mr. Scrope mentions the superior heat of deep mines, as favoring the opinion that there is a great internal heat in the earth. If we mistake not, it has been ascertained that this arises from the superior density of the air, on account of the greater pressure, upon the same principle that the greater tenuity of the air contributes to the coldness of the higher regions of the atmosphere. When mines are occupied by water, there is said to be no evidence of heat, but on the contrary, the temperature is lower. The hypothesis of a central heat does not therefore appear to derive support from this source, although we think it would not be difficult to prove that there are physical causes, with whose nature and energy we have sufficient acquaintance, to justify us in believing that ignition may at any time be generated in the bowels of the earth.

"The author now proceeds to examine the laws which determine the *disposition* of volcanic products on the surface of the globe. The simple cone is first considered, resulting from the accumulation of fragments projected by a series of explosions from a single aperture. Its figure is a truncated cone, containing a funnel-shaped cavity called the crater. The line in which the inner and outward slopes meet is the ridge. Its regularity is liable to disturbance from many causes, such as the fissure-like form of the vent, which usually gives an oblong figure to the cone; the vicinity of other vents; violent prevailing winds; and, above all, the subsequent emission of a current of lava from the same orifice by which one side of the crater is broken down. Examples of these, and other varieties of figure, are given from Auvergne, Italy, &c.

"The composition of the cone is next dwelt on, and the nature of the fragments, which are either, 1. *Scoriæ*, or portions of lava torn from the surface of that which has risen within the vent, by the explosive escape of the ascending volumes of steam. The distinctions of shape, structure and size, are accounted for, particularly the difference of the scoriæ of feldspathose lavas (pumice,) and those of basaltic composition. 2. Fragments of other rocks broken from the sides of the fissure by the force of the ascending fluids. These may consist of primitive, secondary, or any class of rocks. The remarkable fragments found in the conglomerates of Somma, and Eiffel, are attributed to the alteration of calcareous and granite fragments by the volcanic heat, new minerals being produced from the decomposition of these, and the reaggregation of their elements in other forms. Fragments of either kind are, if the eruption continues long enough, completely pulverized by repeated projections. The electric phenomena, developed during eruptions, are supposed by the author, to be owing to this immense friction. The height to which fragments of a large size are carried, exhibits the prodigious escaping force of the steam bubbles. Vesuvius has been seen to launch scoriæ 4000 feet above its apex, Catopaxi 6000. The latter projected a mass of rock of 1000 cubic feet to a distance of three leagues. This explosive force proves the vapor to be propelled from a great depth, and at an intense heat. A volcanic cone is shown to be stratified in planes parallel both to the inner and outer slopes of the hill; and, owing to this peculiarity of structure, the character of such a hill may be recognized even from the smallest remaining fragment. A plate gives a view of the Capo de Miseno, which offers a natural section of such a cone. The author next discusses the laws of the protrusion and disposition of lavas, when expelled, *en masse*, in a more or less fluid state from the volcano; beginning with a notice on the mineral nature of lavas, and their differences of specific gravity and texture, by which their *fluidity* is invariably determined. He classes them into the *heavier* lavas (basalt,) in which the ferruginous mineral, augite, hornblende, mica, or titaniferous iron, are abundant; and the light lavas (or trachytes,) in which the minerals are rare, and felspar, or some equivalent of low specific gravity, almost the sole ingredient. The *fluidity* of a lava, or the facility with which it moves in obedience to its own gravitating force, is compounded of its *liquidity*, of the mobility of its parts, and of its specific gravity. But the liquidity of lavas, it has been seen before, varies with the average comminution of their crystalline particles, under the same circumstance of pressure and temperature. Hence lavas, of the same mineral quality, and therefore of equal specific gravity, when produced under similar circumstances of temperature and pressure, will possess a degree of fluidity inversely proportioned to the average size of their crystalline particles, or *grain.* And, *vice versa*, when their grain is of the same degree of fineness, their fluidity will be proportioned at their specific gravity, *i. e.* to the proportion of ferruginous minerals in their composition.

"The author illustrates these propositions, by showing, from observation, that the basaltic lavas have generally flowed farther, and spread over a larger surface than the trachytic; and also that the lavas of either class have spread in a horizontal direction, more or less in proportion to the adundance of the heavier minerals in their composition, and the fineness of their grain. The fact has been long ago remarked, but the explanation of it, is presumed to be novel. The disposition of a body of lava, emitted from an orifice in the surface of the earth, is in strictness, determined by, 1. The force of expulsion—2. Its fluidity—3. The external circumstances that may render this fluidity more or less permanent—4. Those which favour or impede the lateral extension to which it is urged by its fluidity. On the compound influence of these circumstances depends the direction taken by the lava, the velocity of its progress, the extent of its superficial spread, and consequently, the figure of the rock into which it congeals. According to these, lavas assume the form either of sheets, streams, hummocks, or domes. Examples are given, in numbers, of their modifications of form; and it is observed, that the general bulkiness of the trachytes is simply accounted for by by their imperfect fluidity, (owing to a coarse grain and low specific gravity) without presuming that they have swelled up like a bladder from below, according to the vague and anomalous idea of Humboldt and De Buch. The author proves, from his own observations however, in opposition to the statements of Beudant and other writers, that, under favorable circumstances, the trachytic lavas have often spread into bulky *sheets* and *streams*, (*nappes et couleis*) particularly in the Mont Dor; from which he gives a section where beds (slightly inclined away from the centre of the mountain with a quâquâversal dip,) both of trachyte, (of the *standard* tratchyte of the French geologists) and of basalt, alternate with *each other*, and with interposed beds of ashes, or volcanic conglomerate. The author mentions one vast stream of feldspathose lava (clinkstone) which appears to have flowed from the summit of the Mezen, in Velai, into the bed of the Loire, thirty miles distant, with an average width of six miles, and a thickness of 500 feet; thus rivalling the colossal trachytes of the Andes. Clinkstone, or the laminar variety of trachyte, is presumed to have possessed in general a superior fluidity, owing to the parallelism of its crystals, as a very small proportion of elastic vapour interposed between these would give a great mobility to the mass, *in the direction of their longest axes.* The crystals of all lavas, indeed, are supposed by our author, when in motion, rather to slide or slip past one another by means of the intervention of a small quantity of fluid between their flat surfaces, than roll over one another, as is probably the case with the globular particles of perfect fluids. This would naturally result from their peculiar kind of fluidity, and also explains the extreme difficulty with which lavas in motion are induced to swerve from the direction they have once taken. The smallest obstacle is sufficient to check their progress for some time, and even to consolidate the lava to some distance back from the obstacle. These solidified parts, when again broken up by the increased impetus of the lava behind, occasion the *brecciated* character of some lavas, where angular fragments are enveloped in a paste of the same material. The zoned and ribboned structure of pearl-stones is similarly accounted for. This sluggishness of lava currents occasions great accumulations of the substance on those points where its motion was checked and diverted, as in the angles of water courses, &c.; and examples are given from the Vivarais, where huge patches of columnar basalt occupy the concave elbows of the gorges of the granite mountains, the connecting strips being shallow, or having altogether disappeared. The curious procedure of lava, when it meets with a perpendicular obstacle, such as a wall, which it cascades over *without touching it*, is then noticed and explained; as also the arched gutters and caverns often formed from its subsidence; and its effect on grass, trees, and fragments of other rocks; on marshy ground, and when it enters the sea or any body of water. Its progress below the water is shown to be similar to that on dry land, though slower, with the same degree of fluidity. The water is heated and discoloured by it, and fish often killed in numbers. The fossils of Monte Bolca are attributed by our author to such a catastrophe, since the beds in which they occur are topped by basalt and volcanic calcareous conglomerate."

The display of electrical phenomena during volcanic eruptions is often very brilliant; Mr. Scrope remarks that this was the fact with the eruption of October, 1822. "From every part of the immense cloud of ashes which hung suspended over the mountain, flashes of forked lightning darted continually. They proceeded in greatest numbers from the edges of the cloud. They did not consist as in the case of a thunderstorm, of a single zigzag streak of light; but a great many corruscations of this kind appeared suddenly to dart in many directions from a central point, forming a group of brilliant rays resembling the thunder bolts placed by the ancient artists, in the hands of the clould-compelling Jove.

" The consolidation of lavas is next treated of. This is effected equally by the condensation or escape of its fluid vehicle. Its condensation takes place either by increased pressure or diminished temperature. This mode of consolidation is supposed peculiarly favourable to the reunion of many of the disintegrated crystals, the gradual diminution of the vapour bringing the particles by slow degrees within the sphere of their reciprocal attractive forces, while the remaining elasticity leaves a sufficient mobility to permit of the reversion of their poles in obedience to these forces; and thus a partial recrystallization may be expected to take place. Such crystals, it is shown, will have their longest dimensions perpendicular to the pressure upon that part of the lava.

" But that portion only of the elastic fluids will be condensed, which cannot effect its direct *escape*. This is completely prevented in some cases, as in *dikes*, &c. But where the lava is exposed to contact with air or water, this escape takes place to a greater or less degree, in one or both of two modes: viz. 1. By ascent in bubbles through the liquid lava. The more fine-grained the lava, the more spherical the bubbles, from the equalization of the pressure on all sides. These vesicles are often elongated as the lava moves onwards; their size will be proportioned to the specific gravity and liquidity, in other words, to the fluidity of the lava, and the same circumstances determine the proportion of vapour which escapes in bubbles, to that which remains behind. Of the latter, a part escapes in the 2d mode, viz. by percolation through the pores and crevices of the already solid exterior. This process advances from the surface inwardly, with a rapidity proportioned to the porosity of the resulting rock, which will vary directly with the average size and irregular arrangement of its crystalline particles.

" From these considerations, the author deduces the following propositions, as to the conduct of differeut varieties of lava, when protuded upon the surface of the earth.

" 1. If of extremely fine grain, and low specific gravity, the superficial congelation of the mass will be rapid, that of the interior slow: its fluidity considerable; air-bubbles spherical, sometimes elongated horizontally or vertically; the scoriæ of such lavas is pumice. Owing to the extreme slowness of the consolidation of the interior, and its great mobility of parts, a more or less perfect recrystallization, or concretionary process, will take place. Pearlstones, radiated or not, or variolites, will be produced; and these concretionary parts, if subsequently drawn out by the renewal of motion in the lava, will give rise to veined, marbled, and brecciated rocks. Numerous examples are given to show how completely these anticipations accord with observation.

"2. A higher specific gravity, with an equally fine grain, increases the fluidity of the lava and its extent of lateral spread; the bubbles of vapour will rise with greater force to the surface, which they will rend and break up, leaving it bristling with asperities from the rapidity with which the exposed surfaces congeal. Beneath this surface large cavernous blisters will be frequent; and the lower part of the current, on the contrary, very compact. The great slowness with which this lower part congeals will afford scope for the play of affinities, modified by the extreme fluidity which it derives from its high specific gravity, the result of which, as is shown in a subsequent chapter, will be tendency to the prismatic or columnar divisionary structure. The fine grained basalts are specimens of this variety.

"3. A coarse grain, coupled with a high specific gravity, by diminishing the fluidity of the lava, increases the bulk or thickness of the beds into which it is disposed, creates a porous texture, and a general dissemination of rude angular cells. Such a mass will contract greatly on cooling, and exhibit wide and numerous fissures of retreat; by which the surface of the current particularly, will be shattered into rude flakes or angular fragments.

"4. A lower specific gravity, together with a large crystalline grain, by wholly preventing the vapor from uniting or ascending in bubbles, will render the mass still more generally porous, and more bulky in figure; as is, in fact, the case with the earthy trachytes, lava sperone, piperno, &c.

"5. When the component crystals are still larger, that is less disintegrated, nearly the whole of the vapour will be condensed by gradual cooling, without much derangement in the position of the crystals, and the rock will, therefore, be more compact and freer from pores. Some of the very large grained trachytes, dolerites, syenites, and granites may be taken as examples of this structure. If the crystals are non-conformably arranged, the fluidity of the lava is at its minimum. If conformably, as in the clinkstones, and other laminar crystalline rocks, the fluidity may be considerable in the direction of the parallel plane surfaces of the crystals.

"6. Some masses of crystalline rock, the author supposes, may be occasionally elevated in a *solid* state, (by the expansion of lava at a great depth beneath,) without suffering any disintegration whatsoever, having either been previously cooled down, or being preserved from ebullition by the pressure of overlying strata, which are elevated together with them. Such a circumstance would be in complete conformity with all the laws of subterranean effervescence, and in the granitic axes of most mountain chains, we recognize facts which can only be accounted for by such a mode of production.

"The aqueous vapours that escape from most lavas, as they are consolidated, are accompanied by mineral substances, which become more and more abundant as the lava cools, and the quantity of steam exhaled diminishes. These substances are, by the author, supposed to proceed from the internal decomposition of some of the ingredients of the lava by its intense heat, as the pressure created by the elasticity of the interstitial fluid diminishes, owing to its expansion and partial escape through the pores and fissures of the rock above. Specular iron is evidently a sublimation produced in this manner, as well as the delicate crystals of hornblende, augite, melilite, and other minerals which occur in the cellular cavities and fissures of some lava rocks. Sulphur is similarly sublimed, and the same origin must be allowed to the sulphates of lime and ammonia, the muriates of soda and ammonia, &c., which are deposited often in great abundance at the sides and edges of the *fumarole*. Other minerals resulting from this internal decomposition are taken up in solution by the steam, and deposited in crystals of concretions, calcareous, siliceous, &c. in the vesicular cavities of the rock. The cells of most amygdaloids are, however, supposed to have been filled by subsequent filtration of water, carrying in solution mineral particles from overlying rocks, and the author supposes the pressure of a high column of water, (as in lavas of submarine origin,) necessary to effect its penetration through the minute-pores of the lava rock.

"The sulphuric and muriatic acids are also often met with among the emanations of the *fumarole*, and their action on the lava composing the sides and borders of these crevices, produces new decompositions and combinations. The sulphate of alumine of the Italian and Hungarian alum works has this origin. These superficial alterations of lava have acquired for the spots where they occur, and which are always within the craters of some volcano, the name of solfatara or souffrière.

"Thermal springs, and the generality of mineral sources, are attributed by Mr. Poulett Scrope to the condensed vapors escaping from a subterranean mass of lava. Some are intermittent like the Geisers, and the cause of this phenomenon, is dwelt on, and explained. The permanent gases evolved from lavas are next treated of; and an instance related by M. Bory de St. Vincent, of seven or eight birds being seen to drop suddenly, while flying over the volcano of Bourbon, is supposed to offer some confirmation of the poetic fable respecting the Lake Avernus.

"The circumstances which determine the time occupied by lavas in cooling, will depend on the figure of the mass, external circumstances, and the structure and composition of the lava. Instances are quoted of currents retaining a great heat for a considerable time. That of Jorullo, in Mexico, is by no means cool yet, though produced in 1759.

"The next chapter treats of the divisionary structure assumed by lavas on their consolidation. This process must be accompanied, at all times, by a diminution of volume or contraction. Were it to commence at the center of a mass no separation of parts need take place; but if at the surface, different centers of contraction must establish themselves, and fissures of retreat be formed between them. The figures these circumscribe, tend to approximate to the hexagon. But since there is no opposition to the contractile force, in a direction perpendicular to the surface, which subsides freely as the mass below contracts, no fissure, or very few will be formed parallel to the surface; and by the inward propagation of the retreat, the hexagons will be lengthened into hexagonal prisms. The slower the process of solidification, and the finer the grain of the lava, the more regular will be the prisms, *ceteris paribus;* hence the interior, or lowest parts of a current alone, in general, require this structure, which does not become visible till denudation has exposed these parts. This is rarely the case with recent lavas; and hence arises, according to our author, the common error of supposing the columnar division confined to the older basalts. This structure is very frequent in dikes, both in the older and recent volcanic formations; the columns being always perpendicular to the sides of the dike. When lava rests on a convex surface, the columns diverge; when on a concave, converge upwards; being always perpendicular to the surface on which the process first acts. The author remarks, that those of the *peaks* of basalt, which are so numerous in basaltic districts, will be found to consist of a group of convergent columns; this disposition affording the maximum of resistance to the action of rain and frost, in separating the columns, and breaking up the bed, of which the remainder has probably been destroyed in this manner. More than one kind of divisionary structure may occur in the same rock; smaller prisms are sometimes formed within the large. The globiform structure is next accounted for, and its occasional subdivision into radiating prisms, or concentric leaves. The angulo-globular structure accompanies a tendency to the formation of globular concretions. The tabular, lamellar, and slaty, or schistose divisionary structures, are supposed to be confined to lavas in which the crystalline particles are disposed more or less conformably, owing to which their mobility is considerable in the direction of their parallel plane surfaces and null in the transverse direction. Hence, retreat fissures will be produced in abundance, parallel to the largest plane surfaces of the crystals, and few or none will be formed transverse to these. By the frequency of such transverse fissures, the cubical or rhomboidal structure is produced.

"The author next touches on the question, as to the cause of the difference of mineral composition in lavas. He inclines to attribute this variety to certain alterations undergone by the rock, originally of an uniform (perhaps granitic) composition, during its rise to the surface of the globe; which was probably attended by repeated alternations of intumescence and reconsolidation, from changes in the relative proportions of the intense heat and pressure to which it was subjected. The principal varieties of lava are found in nature to have been usually produced successively often alternately, from the same or proximate vents. The opinion of the *antagonism* of trachyte and basalt, put forth by Humboldt and Beudant, is combated by our author, and numerous examples adduced of their successive emission from the same volcano. He then notices on the error of limiting the production of trachyte or basalt to particular ages of the globe, or making "formations" of them—both are produced before our eyes by recent and still active volcanos; the error arises from the terms trachyte and basalt, not having been confined, as of right to a mineralogical meaning.

"Having thus far traced the laws which determine the disposition of the substances produced by a single volcanic eruption, whether in a fragmentary form, or as more or less liquid lava, the author proceeds to examine the circumstances that result from the accumulation of such products, by repeated eruptions from the same vent. The simple cone by this process, becomes enlarged into a *volcanic mountain* composed of hardened lava-streams, (each of which acts like a solid rib or buttress to the hill,) and intervening beds of conglomerate. The sides of this hill, are frequently, during eruptions, split by the pressure of the column of lava, within the central aperture or chimney of the volcano. The lava then flows out through orifices, formed successively at different levels, one below the other; examples of such occurrences are given from the phenomena of Ætna, Vesuvius, Iceland, &c. It is a general fact, that, in the eruptions of volcanic mountains, or *habitual volcanos*, the elastic fluids are chiefly discharged from the central crater, but the lava is emitted from apertures in the side, or at the base of the mountain. Minor and local earthquakes are occasioned by these rendings of the frame-work of the mountain, which is even sometimes split in two. The consolidation of the lava that occupies these fissures, produces numerous vertical dikes, which cutting across its other component beds, acts as braces or ties to the frame-work, and increase its general solidity. Somma presents an example of such dikes in great numbers. The fissures are in this manner hermetically sealed, as it were, and never open a second time. Thus, with the height and bulk, the strength of the mountain increases, without any conceivable limit; and the author thinks it an erroneous idea, that such limit exists, and that, at a certain height, eruptions can no longer take place from the summit of the cone, since every lateral eruption adds to the strength of the mountain's flanks, and to the resistance they oppose to the lateral pressure of the internal column of lava. *Parasitic* cones are thrown up by the gaseous explosions which take place from these lateral vents. They have each their crater, and each marks the source of a current of lava. Ætna has nearly seventy such cones scattered on its flanks, many of considerable size. Vesuvius exhibits but a few, but is itself a parasitic cone, thrown up in the centre of the old crater of Somma. The skirts and base of a volcanic mountain are usually covered with conglomerates of an alluvial character, deposited by torrents of water, proceeding either from the violent rains, which usually follow an eruption, or from the melting of snows. These debacles of mud and water, are called by the inhabitants of Vesuvius, *lave d'acqua.* In Iceland, they constitute the most destructive part of the volcanic phenomena. Such deposits are often carried to some distance from the foot of the mountain, and are found alternating with the currents of lava which have flowed farthest from the centre of eruption; trees and plants are found buried in them. The *surturbrand* of Iceland is of this origin. If the sea washes the foot of a volcano, these, and other of its products, will be mingled with marine deposits, and often carried by currents to a distance. This was the origin of the stratified tufas of Campania, and the environs of Rome. In Hungary, pumice conglomerates alternate with tertiary limestone, as basaltic peperinos do in Auvergne, the Vicentine, and the Val Demona in Sicily.

The craters of volcanic mountains are subject to a series of changes, by which they are alternately filled up and emptied again. The large crater, left by any paroxysmal eruption, is gradually filled by the accumulating products of minor eruptions, until it is replaced by a convexity of summit. This form is, as we have seen, the most favourabe to the permanence of the eruptive process; but at the same time, the quantity of matter accumulated above the focus, and, therefore, the obstruction to the escape of the caloric in as quick a ratio as it is received there from below, is at its maximum; consequently, the probability of the recurrence of a paroxysmal eruption, from this inferior focus, is greatest at this time, and such a phenomenon will, therefore, probably soon occur. By this, the mountain is once more gutted. The crater left by these paroxysms, is usually a deep elliptical chasm, resulting from the enlargement of the original fissure of eruption, by the violent ascent of the elastic fluids. Examples are given, in great numbers, of such craters, and of the changes they have undergone. Paroxysmal eruptions of this kind have, in some instances, blown into the air the whole frame of the mountain, and replaced it by a lake. The eruption of Vesuvius in 79 A. D., is supposed to have thus shattered one-half of the original cone of Somma, burying Pompeia and Herculaneum under its fragments. Such craters are often occupied afterwards by lakes, particularly where the conglomerates are of a feldspathose nature, since these form, by mixture with water, a mud or clay, which is impervious to water. Other lake-basins, in volcanic districts, are formed by explosions from a deep focus, on some fresh point of the earth's surface, as are some in the Eiffel and Auvergne, which have been drilled in this manner through rocks of greywacke slate and granite, the fragments of which are scattered on all sides. The bursting of lakes in the interior of volcanic craters, gives rise to what the author calls, Eluvial deposits; the trass of the Rhine, the moya of America, and some tufas, are attributed to this origin. These conglomerates sometimes assume a divisionary structure on desiccation, and *set* very firmly, so as to be used as building-stone; the tufas, which have not been thus forcibly mixed with water, seldom cohere so compactly. Organic remains occur, of course, also in these conglomerates, particularly wood. The primary vent of a volcano is sometimes shifted laterally; the original crater remaining *extinct*, and usually reduced to the state of a solfatara. Teneriffe and Bourbon are noted examples of this circumstance."

One of the most remarkable examples of the explosion of an entire volcanic mountain happened in 1688 in the island of Timor one of the Molluccas.

The whole mountain which was before this continually active, and so high that its light was visible, it is said, three hundred miles off, was blown up and replaced by a concavity now containing a lake.

"The next chapter is upon Subaqueous Volcanos, which are supposed by Mr. Scrope to be much more numerous than is generally imagined. Indeed, all insular volcanos, (and most of those we are acquainted with are of this character,) have been originally produced by submarine vents.

"The observed instances of eruptions from the sea are indeed few in number. Our author mentions those off St. Michael, one of the Azores in 1638, 1720, and 1811; of Santorini, and the Isola Nuova, in the Archipelago; another off the coast of Iceland in 1782; and one amongst the Aleutian islands in 1814. But, on reflection, we must conclude, that the weight of the water above the vent, and the refrigerating effect of its contact, must, in all cases, condense the escaping volumes of steam, and prevent their rising to the surface, and rendering the eruption visible there, except when the orifice of the volcano has been raised by the accumulated products of repeated eruptions, to within a short distance of that level; so that numerous eruptions may be continually taking place within the depths of the ocean, without our being aware of their occurrence in any way. There is no reason for concluding such eruptions to proceed in any very different manner from those which are *subaerial*. The expansive force and temperature of the lava must be extreme, and proportioned to the great excess of the repressive force occasioned by the pressure of the supported column of water. The lavas, when emitted, will therefore, from the intensity of their temperature, and the resistance opposed by this dense medium, to the exudation of the confined vapor, *retain* their fluidity much longer (than ?) in the open air, and consequently, spread laterally to a far greater distance from the vent, with a similar inclination of surface. According to this, lava beds, produced at the bottom of the sea, ought to exhibit a greater lateral extension, compared with their bulk, than those which have flowed from subaerial volcanoes; and, in fact, the great horizontal dimensions of the flœtz-trap formations of Ireland, Germany, Iceland, Faroe, the Hebrides, &c. have long been a subject of remark. Again, since little or no vapor can escape from the suface of the lava, such beds should show very few scoriæ or scoriform parts on their upper surface; and, on the contrary, vesicles, or air cells, may be expected often to abound through the *interior* of the rock, the extreme tension of the steam causing its parcels to expand as the lava flows on, while the rapid consolidation of the surface, and the weight of the sea above, must prevent their rising upwards.

These characters also accord with the appearances of many of the flœtz-trap rocks, amygdaloids, &c. which seem clearly to be the products of submarine vents. Of the fragments thrown up by the explosions of submarine eruptions, some will accumulate round the orifice in rude beds, others be dispersed by currents, and mixed or interstratified with other marine deposits. In the north of Italy and Sicily, are frequent examples of calcareo-basaltic conglomerates, (peperino,) as well as of beds of basalt, alternating repeatedly with compact limestone strata. The hills of the Phlegræan fields near Naples the author supposes to have been thrown up by subaqueous eruptions from a very shallow shore, which has been subsequently elevated above the sea-level, by subterranean expansion.

"When the summit of a submarine volcano is raised above the surface of the sea, it conforms to all the laws, already investigated, which regulate the conduct of a *subaerial vent.* Its elevation takes place in one or both of two modes, viz. 1. By the accumulation of matter, protruded by repeated eruptions. 2. By elevation, *en masse*, from the expansion of the inferior lava. The latter mode will be often accompanied by the heaving up of more or less extensive masses of the neighboring strata. Examples are given of volcanic islands, which appear to owe their elevation from the depth of the sea to these different processes. Iceland, Teneriffe, Sicily, and some of the Leeward Isles, are quoted as islands which have risen by the joint effect of both the above modes of subterranean activity; the Isle of France, Pulo Nias, some of the Madeiras, and of the Hebrides, as instances of the latter mode acting alone. The author supposes the coralline islands of the Pacific to be mostly based upon volcanic submarine eminences; their circular or elliptical figure corresponding to the ridge of the central crater of a volcano. Many have been subsequently raised far above the level of the ocean; and the earthquakes, to which they are so often liable, prove their elevation to be owing to subterranean intumesence, and to be still in progress, while the continual growth of fresh coral on their shores, augments at the same time their horizontal extent.

"Chapter IX treats of Volcanic Systems.

"The volcanic vents observable on the surface of the globe, are arranged either in detached groups, as those of Iceland, the Azores, Canaries, Cape Verd Isles, &c.; or, and this is the prevailing case, in linear trains, at a greater or less distance; often so close, that the products of the neighboring volcanos are in contact, and produce strings of volcanic mountains, such as occur in France, Germany, the Leeward Isles, Java, Sumatra, Japan, Kamschatka, &c. The most remarkable series of vents of this kind on the globe, is that prodigous train which, beginning in the Andaman and Nicobar Isles, runs through Sumatra, Java, Sumbawa, Sumba, Timor, and the whole group of the Moluccas, whence taking a northerly direction, it has produced the Phillippines and Loochoo Isles, Japan, Jesso, the Kurile group, and the peninsula of Kamschatka. Thence it diverges to the east, forming the chain of the Aleutian Isles, and appears to be continued southerly along the western coast of

North America into California, Mexico, Guatimala, Nicaragua, Panama, and the vast volcanic range of the South American Cordilleras, even to Terra del Fuego. If, as appears most probable, such trains of volcanic vents indicate fissures, broken through the superficial strata by subterraneous expansion, what a prodigious compound fracture in the crust of our globe does this immense chain of volcanos disclose to us. In these systems, some few vents remain occasionally active, others closed, the former acting as *safety-valves* to the neighboring districts. In case of their permanent obstruction, some fresh vents must be produced, or some former orifice re-opened; while violent earthquakes, and elevations of the neighboring strata, will precede or accompany this change. The author then dwells on the appearances in the constitution of the known surface of the earth, which indicate numerous and forcible elevations of strata, by subterranean expansions, more particularly in the elevated or mountainous districts, which according to him, are those points or lines that have suffered the maximum of elevation, from the extreme developement of the expansive process beneath them. But since, as has been stated above, and as is shown to be conformable to observation from a variety of instances, the existence of active volcanos obviates the occurrence of such extensive elevations of the superficial strata, by letting off, through fissures in these strata, the superfluous caloric, which would otherwise accumulate and produce successive powerful expansions in the great bed of lava beneath them, we must expect to find such spiracles to be frequent in the lower levels of the globe's surface, and rare in those higher,—and this is precisely true to the letter; for we know of very few volcanic vents in the interior of the continents, or amongst mountain ranges, while they rise in vast numbers from the depths of the ocean. If the Andes are urged as a striking exception, it is replied, that this great range is itself composed almost wholly of volcanic, or at least, *pyrogenous* rocks, which, like Ætna, Teneriffe, &c. have swelled to their immense height by the accumulated ejections of very productive vents.

"But, notwithstanding the distance usually interposed between the principal trains of volcanic vents, and the elevated continental ranges, Mr. Scrope thinks he perceives a frequent and remarkable parallelism in their direction. Thus the volcanic trains of France, Germany, and Italy, run decidedly parallel to the opposite ranges of the Alps and Apennines; that immense chain which encircles the Pacific, is almost uniformly parallel to the neighbouring high lands of Asia and America, &c. and he is thus led to suppose, that the creation of *fissures of elevation*, and the protrusion through them, of crystalline rock, chiefly in a more or less solid state, together with the heaving, dislocation, and contortion of the strata on either side the cleft, that process, in short, to which he attributes the production of mountain ranges, was the *immediate* and *primary* result of partial expansions of the subterranean lava-bed at a great depth; while the *fissures* of *eruption*, which give rise to the properly so called volcanic eruptions, on different points of these cracks, were *secondary* and *incidental* results of this process, being chiefly occasioned by the lateral drag of the superficial strata towards the line of elevation, which the action of a powerful force, heaving them upwards on this line, must necessarily produce. The author remarks, that the generalization of this important fact, that the elevation, *en masse*, of the solid strata, composing the crust of the earth, has been inversely proportional to the developement of the volcanic phenomena in the same quarter of the globe, demonstrates, that the subterranean bed of intensely heated crystalline rock, (or lava,) whose local existence was proved in the early part of his essay, must extend generally beneath the whole surface of the globe. The transmission of caloric to this bed, from within, appears also to have been uniform and constant, having produced successive expansions in it, and proportional *elevations* of the overlying surfaces in those parts where no facilities existed for the outward escape of the caloric, and continual *eruptions* attended with little or no elevation, wherever vents were created for the extravasation of the heated and intumescent matter.

"In the Xth Chapter, "on the Developement of Subterranean Expansion in the elevation of strata, and production of continents above the surface of the ocean," the author quits the volcanic phenomena, properly so called, to apply the knowledge with which the investigation of these phenomena has furnished him, on the nature and mode of action of subterranean caloric, to account for the geological features of the continental formations. And herein appears to consist a main distinction between the geological theory brought forward by Mr. Poulett Scrope, and those of Hutton, or other writers on the same subject, who may seem to have forestalled him in some of his principal conclusions; viz. that, while the latter class of theorists directed their efforts to prove that the chief appearances in the constitution of the earths crust could only, or could most rationally, be explained by the hypothesis of an intense central heat producing elevations, &c., the author we are at present reviewing, directly demonstrates the existence of this central heat, and elevating power, from the phenomena of volcanos and earthquakes; draws from the same source, conclusive evidence of the laws under which it acts; and goes on to show, that such a power must, in the nature of things, have given rise to those elevations of continents and mountain ranges, with all the minor phenomena of inclined and distorted strata, dikes, veins, faults, &c. which it is one of the chief objects of geological inquiry to account for.

"This chapter commences with the remark that the arenaceous and sedimental strata, which compose the major part of the surface of our continents, are found to assume a great degree of inclination, and more irregularities of position, as we approach the chains of mountains, or lines of maximum elevation and disturbance. They, however, almost universally lean against masses of crystalline rocks, which form the geological axis of every mountain. Of these rocks, some are stratified, or rather have a laminar structure, as gneiss, mica-slate, &c., and show marks of the action of some violent force upon them, in their repeated flexures, cracks, and highly inclined position; others are unstratified, (granite, syenite, porphyry, serpentine, diallage-rock, and greenstones, &c.,) and usually underlie the others, or cut through them in the manner of immense dikes. The latter are supposed by the author to be portions of the subterranean crystalline bed, protruded by inferior expansion, sometimes in a state of partial liquefaction, at others as a solid mass, through a longitudinal cleft broken across the superficial strata. The laminated crystalline rocks, which formed the lower portion of these strata were forced likewise through the fissure by the tremendous friction of the rising mass, and, during this process, were folded into repeated doublings, like those produced in a bale of cloth or linen, by a powerful pressure, acting nearly in the direction of its layers. In general, the central axis of unstratified crystalline rock, will appear like a vast dike intruded between the replicated schists on either side; at others, these protruded strata will still cover the axis like a mantle. Where the temperature of the exposed parts of the crystalline axis was intense, a superficial intumescence may have taken place, the liquefied matter overspreading the edges of some of the overlying or protruded strata, and thus giving rise to the appearance of secondary granites, syenites, porphyries, &c. Portions of lava will also be injected between the folds of the lower schists; and into any crevices or fractures formed in them. At the same time, the upper strata recede in a lateral direction, from the axis of elevation, slipping down the inclined planes of their stratification, by the influence of gravity, and become also more or less bent and folded together, owing to the resistance opposed to this subsidence, by the inertia of their distant unelevated parts. Curvatures and replications could, however, only take place where the strata were in a semi-solid state, or where the peculiar structure of the rock was favourable to the partial mobility of its parts; and this appears to have been particularly the case with the laminar and schistose rocks, whose parallel plates of mica are enabled to slip, with more or less facility, over one another; such rocks appear to have often suffered an extraordinary degree of replication. By the subsequent destruction of the extreme flexures of these folded strata, they seem, to a traveller passing across their edges, to alternate repeatedly in a recurring series. Where the induration was more complete, or the structure of the rock unfavourable to flexibility, as in the compact and massive limestone formations, numerous fractures, fissures of all sizes, often of great width, will have been broken through them, and the intervening masses of strata more or less dislocated and disturbed in their position, sometimes, perhaps, left in isolated patches on summits or flanks of the protruded crystalline rocks. This appears to have been the origin of the insulated pyramids of dolomite, which rise from the great porphyry district of the Tyrol. Indeed, any one acquainted with the aspect of the limestone formations of the whole range of the Alps, will acknowledge, that, in this irregularity of position and inclination, their perpendicular escarpments, and chasm-like vallies, these vast masses of strata accord precisely with what might be expected from a mode of elevation, such as is here attributed to them. Thus, of the fissures broken through the elevated strata, those which descended sufficiently in depth, and opened into the inferior lava-bed, occasioned extravasations of this substance, producing *dikes*, &c. others which were too narrow and intricate to allow of their occupation by the intumescent matter, were yet permeable to the vapors that rose from this subjacent and intensely heated mass, bringing with them both earthy and metallic sublimations, which would be deposited on the sides of the fissures, together with fragments broken from these sides, or fallen from their upper parts, whence the *mineral veins*. Those fissures which did not communicate with the heated lava-bed, were filled in part, or altogether, by rubbish alone, and these are the *faults* or *slips* of miners. The formation of calcareous and other *breccias* and *veined-marbles*, is accounted for by the smallest of these fractures; the still unconsolidated juices of the rock oozing into its cracks and crevices, and filling them with a deposit of *finer* matter. The quartz veins of the arenaceous and micaceous rocks are attributed to the same process.

"The author goes on to draw a distinction between the *primary* range, or axis of elevation, along which the overlying strata were burst open and elevated, solely by the developement of subterranean expansion beneath, and those *secondary* ranges, or axes of elevation, which consist in the convex flexures produced on either side of, and more or less distant from, the primary axis, by the replication of the elevated strata, as they slipped away from this axis. Whatever expansions took place in the inferior crystalline mass beneath these secondary convexities, were occasioned by the reduction of pressure on it, not by the absolute increase of its expansive force, as in the primary axis. These secondary ridges are more or less parallel to the primary. The occurrence of proximate ranges of elevation, or any other causes productive of local variations in the resistance opposed to the lateral movements of the strata, would occasion proportionate aberrations from this parallelism. The intervals between these parallel ranges, that is the concave flexures, or fractures, produced the longitudinal vallies of mountain districts. In the north of Scotland, such vallies, separated by intervening secondary ridges, are numerous and remarkable, forming the basins of the greater number of her lakes and æstuaries. The author supposes even the great valley of Switzerland, on one side of the Alps, and that of Lombardy on the other, to be examples of longitudinal valleys having this origin. The range of Jura on one side, and that of the Appenines on the other, are in this view, the secondary ridges occasioned by the replication in the strata, which were driven laterally towards the north and south by the forcible elevation of the primary range of the Alps. In England the flœtz strata are supposed, by the author, to have slid in a lateral direction towards the German ocean from off the elevated range of Devon, Wales, Cumberland, and Scotland.

"But besides the longitudinal fractures of the superficial strata, others will often have been formed in a direction *transverse* to the axis of elevation, by local irregularities in the mode or time of elevation. Many of the transverse vallies of mountain chains are referred to this origin, particularly those deep chasm like gorges which contain lakes at the foot of the higher Alps, both on the north and south. The waters of the ocean retreating from the surfaces, thus suddenly raised above their level, would retire with immense impetuosity through these fissures, and enlarge and deepen them, leaving vast accumulations of transported fragments at the lower extremity of such gorges, where the velocity of the debacle was first checked. (Diluvium of Switzerland, Piedmont, the Italian lakes, &c.) Other transverse vallies were, perhaps, wholly scooped out by these retreating waters, which would excavate their channels along those lines into which they were directed by the accidents of level, and the greater or less resistance of the rocks over which they rushed. These vallies, according to the author, have been enlarged and modified, and many others, particularly all the smaller ramifications, entirely excavated, by causes still in action, more especially the fall of water from the sky, and the erosive force of its descent from higher to lower levels. It is remarked, that there are good reasons for concluding that the quantity of water circulating over the globe's surface in this manner, in given times, has progressively diminished, with its diminution of temperature, from the earliest ages of the world; so that we need not shrink from attributing to its agency, effects far exceeding in magnitude those of which it appears capable at present. "One decided proof of the slowness of the process of excavation, wherever it occurs, exists in the *sinuosity* of water channels, and in such a case, are met with even amongst the largest river vallies, it is idle to talk of transient deluges or debacles as the excavating agent."

"With regard to the periods at which the different continents may have been heaved upwards, our author concludes from the analogy of the volcanic phenomena, that such elevations took place by successive shocks; the greater number being of minor violence, similar to the earthquakes which occur at present; but some of prodigious power, (paroxysmal expansions,) and analogous to the paroxysms of habitual volcanos. If it is true, that outliers of the plastic clay and chalk have been recognized on the highest summits of the Alps, it would appear that this colossal chain, and perhaps with it the whole continent of Europe, owes its elevation from beneath the sea to some catastrophe of this nature, at what we are accustomed to reckon a comparatively recent geological epoch. The traces of diluvian action, the boulders of the Alps and Sweden, and the alluvium of the north of Europe, may have been produced by the retreat of the ocean from this elevated surface, and the successive oscillatory movements to which it must have been subjected before it regained its level. Other paroxysmal expansions may have occurred in earlier ages of the globe's history, and in the old red sandstone formation, it is observed we may perhaps trace the result of such a catastrophe. The occurrence of repeated elevations on a large scale, is, indeed, attested by numerous geological facts. It is also probable, from what we know of the power by which they are occasioned, that they were far more frequent and violent in the early part of the history of the earth than they can be at present; for, unless we suppose the proportion of caloric transmitted from the interior of the globle towards its surface to have been always on the increase, (which is directly the reverse of the opinion professed by the author,) it is clear, that the continual and general increase of the repressive force, by the additions made to the solid strata of the globe, in the products of volcanos, and incrusting springs, and also to the body of water and atmospheric fluids which press upon that surface, must have proportionately diminished the ratio of subterranean expansion, from the commencement of the process up to the present day.

The author then adverts to the mineral nature of the general subterranean bed of crystalline rock, (or lava.) This he concludes to be probably granitic; and supposes that some of the elevated portions of it, may, by the effect of repeated intumescences, and reconsolidations, under varying circumstances of temperature and pressure, by which the component minerals would be more or less disintegrated, decomposed, and their elements recombined in new proportions, and on separate points, have been converted into syenite, greenstone, porphyry, compact felspar, serpentine, diallage rock, &c. The analogy of ordinary volcanic rocks, in which such changes to a certain extent, indisputably take place under similar circumstances, supports this conjecture; and since all the above varieties of rock are found in nature to graduate into one another, it cannot be unreasonable to suppose all may have been elaborated from the same *raw material.*"

The sequel of the analysis might be omitted with less injury than the preceding, because the authors views are more hypothetical; but long as this article has been, we are not willing to suppress the remainder.

"The work would appear to have terminated naturally here, at least the author is anxious to keep the part of which we have now given a summary, and in which he has endeavored to confine himself within the bounds of strict logical inference, (deducing from the evidence of the volcanic phenomena, a certain degree of knowledge as to the nature and mode of operation of subterranean caloric, and applying this knowledge to account as well for the detail of these phenomena, as for the inequalities in the surface of the globe,) separate from the concluding chapter, which contains theoretical matter of a more general and less substantial character; in short, an attempt to sketch the outline of what may be called the History of the Globe.

"To this, indeed, the author was naturally led by the results of his previous investigations; for having proved the existence of a vast subterranean reservoir of caloric, the effect of which is still to occasion violent changes in the superficial crust of the globe, and which appears to have formerly produced similar changes of far greater magnitude, it is impossible not to suppose the same cause to have had a large share in the original formation and disposition of that crust. In fact, the elevating process, which, in the foregoing chapter, is shown to have produced the present irregular disposition of the superficial rocks, presupposes a peculiar arrangement of these beds, previous to their elevation above the sea level.

"The crust of the globe must then have been composed of concentric coats, consisting of 1st, The secondary and transition series of strata; 2dly. The series of laminar and schistose crystalline rocks, viz. gneiss, mica-talc and chlorite, schists, &c.; 3dly, and finally, the granitoidal matter confined at an intense heat by the compression of the overlying strata.

"The origin of the sedimental and arenacious deposits of the ocean, composing the first series, discloses itself by the organic remains contained in them, and their analogy to the actual deposits of our rivers, lakes, and seas. The fragmentary rocks apparently owe the magnitude of the scale on which they have been sometimes produced to the violent oscillatory movements to which, as has been noticed above, the ocean must have been subjected by any paroxysmal elevation of a large portion of its bottom. Even where the elevation took effect only on strata already raised above the sea level, the effect on the waters of the globe would be still most powerful; for the *radius* of the *globe being dilated on that point*, a proportional body of water must rush immediately towards the opposite, or antipodal point, to preserve the equilibrium of the globe, and a series of violent oscillatory movements must take place general to the whole ocean, and producing a permanent alteration in the relative levels of land and water all over the earth; these effects being proportioned to the mass of matter raised, and the amount of its elevation. The coarser fragments transported by such moving waters, will have been deposited in the longitudinal vallies of mountain ranges, and wherever the currents were first considerably checked. The finer detritus will have afterwards subsided, when the ocean had regained its equilibrium, and mixed with the precipitations which were taking place contemporaneously from its waters, and with the bituminous and calcareous matter, proceeding from the decomposition of vegetable and animal substances, the shells of molluscæ, coralline bodies, &c. produced the sedimentary formation. As the depth of these beds of pulpy matter increased, the consequent pressure upon the lowest of them, by bringing the similar particles slowly and gradually within the sphere of action of their mutual attractive forces, occasioned the successive formation of separate horizontal concretions, *or strata*, more or less fully consolidated, which some subsequent expansion elevated above the sea level, where they lost by drainage all the water they contained, and were by desiccation still farther indurated.

"The author opposes the Huttonian theory, that these strata were hardened by heat from the interior of the globe, which he thinks wholly disproved by the occurrences of clays and shales beneath indurated strata. The consolidation of limestones, sandstones, &c. he attributes solely to a concretionary action, accompanied by a more or less imperfect crystallization of the very finest particles which act as a cement to the coarser. The more complete the process of crystallization, the more solid and campact the rock; and therefore the larger the proportion of precipitated matter, (which as being much finer than any sediment, is more favorable to crystallization,) the more crystalline and the harder will be the strata. It is well known that, amongst the stratified rocks, the older are generally the most crystalline, and hence we should expect the quantity of matter precipitated by the waters of the ocean to have been greater in former times than now. The author attributes this to t e higher temperature of the ocean in those ages, and the greater quantity of mineral matter carried into it in a state of solution by the vapors evolved from the interior of the globe. Even the more completely crystalline rocks, such as statuary limestone, quartz rock, and rock salt, appear to the author in the light of precipitations from the primitive ocean, where at this time the sedimentary matter predominated, mica, talc, and chlorite slates were deposited. With regard to gneiss, the lowest of the stratified rocks, the author considers it to share in a very slight degree in the character of a sedimental rock, to have been in short a granite, which, after a great degree of intumescense, was reconsolidated by the pressure it sustained between the expansive force of the granite beneath, and the weight of the solid strata which had settled above it, as well as of the ocean and atmosphere.

"The author then generalizes these views as to the origin of the different rock formations, in a "Sketch of a Theory of the Globe," of which the following is a brief abstract.

"The mass of the globe, or at least its external zone, to a great depth, is supposed to have been originally granitic, and that, on reaching its actual orbit, perhaps before, a great proportion of the pressure was removed which had previously preserved it in a state of crystallization, notwithstanding its intense temperature, (perhaps as an integrant part of the sun, from which the author is inclined to think it a projected fragment,) according to the notion of Buffon and Laplace.* Violent superficial expansion was the result of this diminished compression; the dilitation decreasing towards the interior, from the surface, which would be completely volatilized to that point where the disaggregation of the granite was wholly checked by the pressure of the zone of

* The author, in a note, compares the globe at this time to an aerolite, in which the superficial crust of vitrified matter bears some analogy to that which then perhaps formed on the surface of our planet.

liquefied matter gravitating towards it. Where the elastic fluid generated between the crystals of the rock, and which occasions its liquefaction, was produced in sufficient abundance, that is, in the outer and highly disintegrated zones, the superior specific gravity of the crystals forced it to rise upwards, and thus a great quantity of aqueous vapor was urged towards the surface of the globe: as this vapor rose into outer space, its continued rarefaction must have lowered its temperature till a part was condensed into water, which fell back in torrents upon the surface of the earth, giving rise to the primeval ocean, which, however, intensely heated below, would be retained in a fluid state by the loss of temperature sustained from the vaporization of its surface, and the pressure of the highly condensed atmosphere upon it. This ocean will have contained, both in solution and suspension, the earthy substances which proceeded from the volatilization of the superficial granite, or which were carried upwards by the ascending vapor from the disintegrated mass below. The dissolved matters were silex, carbonates and sulphates of lime and magnesia, muriates of soda, and other mineral substances which water at an intense temperature, and under such peculiar circumstances, may be supposed capable of holding in solution. The suspended substances were all the lighter and finer particles of the upper beds where the ebullition had been extreme, but, above all, their *mica*, which, from the tenuity of its plate-shaped crystals, will have been most readily carried up by the ascending fluid, and will have remained longest in suspension. When the excess of vapor had effected its escape from the disentegrated granite, the crystals of felspar, and those of quartz, which had remained undissolved by the heated water, subsided first, together with the smallest and least buoyant crystals of mica; and these crystals would naturally arrange themselves so as to have their longest dimensions parallel to the surface on which they were deposited. This mass, when subsequently consolidated by pressure, formed the gneiss formation, which graduates downwards into granite. Upon this, the larger plates of mica and quartz grains would continue to be deposited, while, at the same time, a large quantity of the silex, held in solution by the ocean, was precipitated as the water cooled. Thus was produced, by degrees, the mica-schist formation, graduating downwards into gneiss. On some spots, and perhaps at a later epoch, instead of silex, carbonate of lime was precipitated, together with more or less of micaceous sediment, producing the saccharoidal lime-stones. Upon this mica-schist, and graduating into it, were deposited in turn, as the waters of the ocean cooled, and its local disturbances ceased, or recommenced other stratified rocks, composed sometimes of a mixture, sometimes of an alternation, of precipitated, sedimentary, and fragmentary matter, giving rise to the *transition* formations.

"In this manner was formed the first crust or solid envelope of the globe. But beneath this crust a new process had now commenced, occasioned by the increase of temperature and of expansive force of the upper granite beds; which, having been greatly reduced in temperature by the dilatation it had endured, and the partial vaporization of the water it contained, now began to receive an accession of caloric from the more intensely heated nucleus. The first effect of such an increase in the expansive force of this zone, opposed as it was by the increasing pressure of the strata, whose progressive deposition was going on above, would be to consolidate the intermediate bed of gneiss; the next, to produce, sooner or later, the disruption of the solid crust, which impeded its actual expansion. This result took place on those parts where accidents of texture or composition in the oceanic deposits led to them to yield most readily; and in this manner were formed, in the primeval crust of the earth, those original and deep fractures, through some of which (fissures of elevation) were protruded portions in a more or less solid state of the inferior granite, together with replications of the foliated rocks, (as described in a former chapter;) while others (fissures of eruption) gave rise to local extravasations of the heated crystalline matter in form of lavas, that is, still farther liquefied by the greater comparative reduction of the pressure they supported. By these partial elevations of the superficial strata, violent movements were at times, as has been mentioned before, communicated to the waters of the ocean which broke up the projecting eminences, and distributed their fragments in conglomerate or sedimentary strata. At first, the surface of the globe consisted chiefly of mica-schist; and hence mica and granular quartz predominate in the earlier conglomerates and sedimentary strata, (grey-wacke, grey-wacke slate, quartz-rock.) Precipitations of silex and carbonate of lime, continued to mix with the sediments of this period, and Mr. Scrope supposes quartz rock and transition limestone to owe their dark colors to admixture with the finest particles of mica. For a long time it is probable that local developements of subterranean expansion, producing partial elevations of the earth's crust, local extravasations of crystalline rocks in the form of dykes, beds, &c. and local deposits of conglomerate beds, alternated with periods of comparative tranquillity, during which the finer sedimentary deposits and precipitations took place, and hence the alternations of the various sedimentary and arenaceous strata which compose the secondary formations. Meantime, as the temperature of the ocean decreased, it began to be thickly peopled with organic beings, animals, and vegetables of simple structure; the latter giving rise by their carbonization to the coal strata. At length, as the temperature of the ocean and atmosphere diminished further, the quantity of water taken into circulation decreased; the continents were no longer deluged by perpetual floods of rain, and organized nature took possession of them also; the marine deposits contained less of precipitated matter, and became more earthy, and less crystalline; strata of shales, dull limestones, chalk, marl, sands, and clay, succeeded those of clay-slate, marbles, and sandstones, until the gradual change wrought by the slow refrigeration of the outer zones of the globe brought about the condition in which it exists at present.

"The author remarks that, from the circumstances of their origin, the rock formations of every kind or age must have been more or less strictly *local;* and that, though the formations of any particular epoch will unquestionably have some points of general resemblance all over the globe, it would be absurd to suppose the same series of beds to have been deposited contemporaneously over the whole of its surface.

"The author sums up, by attributing the production of the mineral masses, as at present observable on the surface of our planet, to three sources, distinct in their nature, but of which the products have been often confused and mingled together from circumstances, of isochronism or collocation. These are,

"1. The precipitation of some minerals, particularly silex and carbonate of lime, from a state of solution in water, as its temperature was diminished, &c.

"2. The subsidence of suspended or fragmentary matter from water; together with the accumulation and decomposition of the shells of molluscæ, corals, &c.

"3. The elevation of crystalline matter through fissures in the crust of the globe.

"The author conceives, that all the characteristic differences observable in the successive formations of every kind, may be satisfactorily traced to the gradual diminution in frequency and energy of those productive causes, the varying nature of the original materials acted on and the chemical and mechanical changes they have undergone during the process; and with due allowance for these circumstances, these three modes of production are perhaps fully equal to account for the origin of all the mineral masses of the earths surface. They have also one immense advantage over other hypotheses, and which speaks volumes in their favor, and "*this is, that they are still in operation,*" and producing results completely analogous to those which are here attributed to them. In fact, (the author says,) the theory of the globe, which I have thus hazarded, consists simply in the application of those modes of operation which nature still employs, on a large scale, in the production of fresh mineral masses on the surface of the earth, to explain the origin of those which we find there already.

"If after fair discussion, and with all reasonable allowances, it is found adequate to this purpose, its truth will be established on the soundest possible basis—the same upon which rests the whole fabric of our knowledge on every subject whatsoever, the supposition, namely, that the laws of nature do not vary but that similar results always are, have been, and will be produced, by similar preceding circumstances.

"An appendix is added to this work, containing a list of known volcanos in recent or habitual activity; and an examination of the anomalous phenomena, described by M. de Humbolt, as having accompanied the eruption of Jorullo in Mexico. The work is illustrated by engravings, lithographs, and numerous wood-cuts."

Art. XVII.—*Account of the new Mineral Spring at Albany, with an analysis and remarks; by* Wm. Meade, M. D.

TO THE EDITOR.

Sir—A mineral spring having lately been discovered in the city of Albany, which has excited considerable interest not only from the qualities of the water, but from some curious circumstances attending the manner in which it was discovered, I have been induced to make some inquiries on the subject, which have led me into an investigation of the chemical properties of the water. The result of this inquiry I now beg leave to offer to the public through the medium of your valuable and useful Journal. Wm. Meade.

It appears that in the summer of 1826, Messrs. Boyd & McCulloch, with a laudable anxiety to procure pure water for their extensive brewery at Albany, engaged with Mr. Disbrow, to commence the operation of boring, according to the method which he has submitted to the public,* and in which he has been so often successful. When they had proceeded to the depth of about 480 feet from the surface, instead of obtaining what they expected, they observed that the water

* See Vol. 12, p. 136 of this Journal.

which ascended, had a peculiar saline taste, and a sparkling appearance. During the progress of boring through an uniform, argillaceous, schistose rock, they also observed, when they arrived at the depth of 250 feet, that as they proceeded, a stream of gas, of an inflammable nature, occasionally arose; it was perfectly devoid of smell, but easily took fire when ignited. It was soon perceived that the water possessed sensible medicinal qualities, which induced the proprietor to take the necessary steps for excluding any communication between it and the neighboring springs. A tube, 33 feet long and about four inches in diameter, was accordingly passed down from the surface till it penetrated the rock from which the water originally flowed. It now rises in this tube, within two feet of the surface, and is dipped out, in a glass tumbler for the use of the visitors, exactly in the same manner as is practised at Ballston and Saratoga.

It is not ascertained what quantity flows in a minute, but it is by no means so abundant as the water of the Congress spring, and from the information which I have obtained, would not afford a supply more than sufficient for 4 or 500 visitors daily.

I shall now proceed to give a chemical analysis of the water.

External character, temperature, and specific gravity.

The sensible qualities of this water have a great resemblance to those of the Congress Spring, at Saratoga. Its temperature is uniformly from 51° to 52° of Farhenheit at all seasons of the year; its specific gravity when taken with great care, and after repeated trials, was found to be as 1010 to 1000. When a glass of water is taken immediately from the spring, it is perfectly clear and transparent, and minute air bubbles are seen rising from it which adhere to the side of the glass. The taste of the water is purely saline, somewhat pungent, and by no means disagreeable, but those who are best acquainted with it, think it by no means so stimulating and pungent as the waters of the Congress Spring; it has no sensible chalybeate taste, and no perceptible smell which could lead to the suspicion of its holding sulphuretted hydrogen gas in solution. As to the gas which ascends through the tube and has been described as inflammable, it appears to be either hydrogen or carburetted hydrogen, similar to the gas which is so frequently observed to accompany the saline springs in the State of New York, but which passes through the water without giving it any sensible properties. When this water, which is at first so clear and pellucid, is allowed to remain, for a few hours, in a glass, the gas which is extricated from it, adheres in the form of innumerable air bubbles to the inside surface of the glass; in a short time after, the water loses its transparency, a thin pellicle appears on its surface, which has a slightly irridescent appearance; by degrees the water becomes perfectly opaque, the pellicle falls to the bottom, which as well as the sides of the glass is covered with a light brown powder, which adheres firmly to it. The water after this, recovers its former transparency, but loses its agreeable, pungent, and acidulous taste, becoming perfectly vapid, and has no other taste but that of a solution of marine salt in water.

Examination of the contents of the Albany water by tests or Reagents.

Experiment 1. Litmus paper, dipped into the water when fresh from the spring, has its color immediately changed to red; but this color is fagacious, nor will any such change be produced after the water has been boiled or exposed to the air for any time, which shows that this was produced by a quantity of uncombined carbonic acid and not by a fixed acid.

Exp. 2. Paper stained with turmeric is not altered in color by this water when fresh from the spring.

Exp. 3. Lime water produces an immediate turbidness and precipitation when added in certain proportions to this water. I know not a more decisive or accurate test of the presence of carbonic acid than this, but a variety of circumstances are necessary to be attended to, in order to make a just estimate of it. If equal quantities of lime water and this water are mixed, though at first a slight color is produced, yet the water soon becomes clear again, owing to the excess of carbonic acid which is present in this water, and which redissolves the lime. The usual directions therefore, for adding equal quantities will not succeed, where the water, as in this case, contains an excess of carbonic acid. In order to insure a complete and permanent precipitation of the lime water, one ounce of the mineral water is sufficient to decompose three ounces of lime water. By attending to this circumstance, a tolerably correct estimate may be formed of the quantity of carbonic acid in any mineral water.

Exp. 4. *Tincture of galls* when poured into a glass of the water immediately strikes a purple color, which after standing for some time increases in intensity, till it becomes nearly black.

Exp. 5. *Prussiat of Potash.* A few drops of this, poured into a glass of this water, changes it to a green color, which on standing for some time, gradually becomes quite blue and deposits a blue sediment; the effect of this test is, however, repressed by the quantity of alkaline earth which the water contains, for by previously adding a few drops of marine acid to saturate the earths, I found that the color was much more intense. When the water was previously boiled, neither this test nor that of tincture of galls had any effect, which showed that whatever iron was present was held in solution by carbonic acid gas.

Exp. 6. *Solution of silver in nitric acid.* When a few drops of this solution are poured into the water, an immediate white and ponderous precipitate falls to the bottom of the glass, which after standing for some time, changes to a light purple color. This precipitate is equally abundant, when the water had been previously boiled, which shows the presence of marine acid; indeed a very accurate estimate of the quantity of this acid may be formed by the abundance of this precipitate.

Exp. 7. *Solution of acetate of lead*, when dropped into this water, produces an immediate white cloud and a precipitate. The color of this precipitate decides the absence of sulphuretted hydrogen, as the smallest quantity of this gas immediately changes the precipitate to a black; in the present case, the decomposition of the acetate was caused, either by the sulphuric or the marine acid, and that it was produced by the latter was evident both from the effect of the former experiment, and from the fact that the precipitate was again soluble in distilled vinegar, which would not have been the case if it had been sulphat of lead, which is perfectly insoluble.*

Exp. 8. *Muriat of Barytes*, produces no change in the transparency of the water, either when first taken from the

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*The muriat of lead is also perfectly soluble in boiling hot water, largely added, which forms a good distinction between it and the sulphate and carbonate, the latter being also soluble in acids with effervescence.—Editor.

spring, or after it has been boiled for some time, neither has nitrat of barytes or muriat of strontian the smallest effect on the water. These are decisive proofs that it contains no salt combined with sulphuric acid.

Exp. 9. *Oxalat of ammonia* produces an immediate cloud and precipitate when the water is first taken from the spring, but has a very slight effect when the water is boiled; this shows that the carbonat of lime is held in solution chiefly by the carbonic acid.

Exp. 10. *Sulphuric acid.* When a few drops of this acid are poured into a glass of the water, the first effect is an immediate and brisk effervescence, from the extrication of carbonic acid gas; in a short time, however, a cloud appears and a white powder is deposited; this powder is evidently sulphat of lime, as when nitric or muriatic acids are applied, although the same appearance takes place, no deposition follows, nor is the transparency of the water altered.

Exp. 11. *Carbonat of Ammonia* produces no effect when added to the water fresh from the spring.

Exp. 12. *Carbonat of Potash* does not disturb the transparency of the water.

Exp. 13. *Pure Ammonia* causes an immediate cloud in the water, when added to it fresh from the spring, and a copious flocculent precipitate takes place. This is evidently caused by its combining with the excess of carbonic acid, which holds the calcareous earth suspended, and becoming itself carbonated, as when a mild alkali (a carbonat) is employed, no such effect is produced. Pure potash has precisely the same effect, and for the same reason, but when the carbonates of potash or ammonia are employed no such effect is produced, as has been seen in the previous experiments. When more than is sufficient either of the pure ammonia or potash is added, the precipitate is again redissolved, for the same reason that calcareous earth is dissolved in lime water. In this case an excess of pure potash deprives the lime of its carbonic acid and renders it again soluble; in this way the same may be precipitated or rendered soluble at pleasure.

These are the principal tests which I employed; many more may have been used, but superfluous trials were unnecessary and tend only to perplex rather than to lead to useful conclusions.

Inferences to be drawn from the above experiments.

It appears from the experiments which I have detailed, that this water has a very close resemblance to the waters of Ballston and Saratoga; that it contains muriat of soda, and carbonat of lime, and iron held in solution by carbonic acid gas, and that it does not contain any sulphat, or differ essentially from the Congress spring at Saratoga. Although the use of tests or reagents affords no certain criterion of the exact proportion of any substance which a mineral water contains, yet they are an unerring guide in conducting further experiments, and save much time and labor in looking for substances which they have ascertained not to be present. Thus, experiments 4 and 5 having decided that whatever iron it contained was suspended by the carbonic acid, it was unnecessary to look for any metallic salt. Experiment the 8th having decided that it contained no sulphuric acid, no sulphates were to be sought for. Experiment the 6th having shown the presence of a large quantity of marine acid we of course expect to find a marine salt. Experiment 9th shows the presence of carbonat of lime supersaturated with carbonic acid gas. It then becomes necessary only to ascertain the quantity of this gas, and of those substances which were held in solution by it, which we shall now proceed with as follows:

Examination of the gaseous contents.

The importance of carbonic acid gas, in a medicinal point of view, as well as a menstruum capable of holding various substances in solution, requires that particular attention should be paid not only to the detection of it, but to the quantity which is contained in the mineral water. Various methods have been adopted for collecting it. That which I pursued, on this occasion, was the same which I found both convenient and successful in my inquiry into the chemical properties of the waters of Ballston and Saratoga, published in the year 1817, to which work I must refer for a plate and description of the instrument, only observing now that it consisted of a tin vessel, in the cover of which, a small tube was soldered, in which was placed a glass cylinder graduated in cubic inches. When heat is applied, the gas ascends into the cylinder, and is then easily measured and examined. Pursuing this method, I obtained from one pint of the Albany water, twenty six cubic inches of a gas which was incapable of supporting flame, and was quickly absorbed by lime water, consequently it was ascertained to be carbonic acid gas. This may appear to be a small quantity, but it is nearly as much as any water can contain, of uncombined carbonic acid, under the common pressure of the atmosphere, and at the common temperature.—Few, if any of the natural mineral waters in Europe contain so much; the waters of Pyrmont, Seltzer and Spa, according to Dr. Saunders, contains little more. And if they are more acidulous and pungent, it is because they contain fewer foreign ingredients. It is this gas which suspends the iron and the earths in this water as well as in those of Ballston and Saratoga, which contain a much greater quantity of these carbonates, and are also sensibly more impregnated with carbonic acid: as we shall see by referring to the analysis. Thus according to experiment, the Congress spring contains about thirty-three cubic inches of carbonic acid in one pint or twenty-seven and a half cubic inches of water. The Ballston spring, thirty cubic inches, while the Albany water contains only twenty-six cubic inches in the same quantity.

Examination of the Water after it had been boiled for half an hour.

Having made the above experiments, with the water fresh taken from the spring, and having determined the quantity of carbonic acid gas, with which it is impregnated, I now proceeded in order to obtain more complete indications, to follow up and repeat some of those experiments, after the water had been previously boiled, and thereby deprived of its gas, and of those substances which were held in solution by it.

I therefore boiled one pint of this water, for half an hour, and having filtered it, made the following experiments.

Experiment 1. Nitrat of silver produced the same dense white precipitate as before.

Exp. 2. Acetat of lead was affected in the same manner.

Exp. 3. Litmus paper was not changed in its color.

Exp. 4. Paper strained with turmeric, had its color immediately changed to a dark brown.

Exp. 5. Muriat of barytes does not alter the transparency of the water.

Exp. 6. Oxalat of ammonia produces a very slight cloud in the glass.

Exp. 7. Muriat of lime produces an immediate turbidness in the water, and a deposition of a white powder in the bottom of the glass.

Exp. 8. Tincture of galls has no sensible effect upon the water.

Exp. 9. Prussiat of Potash produces no change in the color of the water.

From these experiments some new light has been thrown on the contents of this water; and it is decisively shown that it has now been deprived of the carbonic acid, the iron and the earths; but it also appears from the result of experiment the fourth, that this water contains an alkali which did not appear from the same experiment, when made previously to the boiling and concentration of the water, nor indeed could it be expected, as the effect of the test was repressed by the carbonic acid, which we have seen, changed the color of the litmus paper. That an alkaline carbonat was present in the water was further evident by experiment seven, producing an immediate precipitation of the earthly carbonat.

To ascertain as nearly as possible, the quantity of alkaline salt which the water contained, I concentrated one pint of it by boiling, and having filtered it, I carefully added pure sulphuric acid, in small quantities, noting the effect with litmus and turmeric paper, till I found the alkali was saturated. To effect this I found required six and a quarter grains of sulphuric acid. Now as it has been ascertained, that one hundred grains of sulphuric acid, are sufficient to saturate eighty grains of soda, it is evident that six and a quarter grains, would saturate about five grains of this alkali. We shall therefore estimate the quantity of carbonat of soda in one pint of the water at five grains.

Examination of the Solid Contents of the Albany water, collected by Evaporation.

Although a tolerably accurate judgment may be formed of the contents of this water, by the use of those reagents, which we have employed, yet the only certain conclusion as to the quantity and character of its solid contents in a given quantity, can be drawn, by submitting it to evaporation, and separately examining the different substances which we have, by these means collected. For this purpose, I proceeded to the evaporation of one pint of the water in a flat porcelain dish, placed in a sand bath, over a steady and moderate fire. As soon as the water became heated to about ninety-two, air bubbles began to arise in great abundance. The water became turbid, a pellicle appeared on its surface, and as the carbonic acid was expelled, a light brown powder was deposited, which increased as the evaporation went on, until towards the end of the process, when it became gelatinous. I now let the whole mass crystalize together, till it assumed the appearance of a light brown powder, which when dried and collected, I found to weigh precisely 71 grains. In order to examine this residuum, being the whole solid contents of one pint of the water, I proceeded as follows. This powder consisting of 71 grains was collected in a phial bottle, and alkohol of the specific gravity of .817 was poured on it to the height of an inch. After submitting it to the action of the alkohol for some hours, frequently shaking the bottle, the whole contents were carefully filtered; after drying the residuum in the same heat as before, I found I had still remaining 70½ grains, so that the alkohol had taken up only ½ grain; indeed the alkohol seemed to have so little action on it, that it appeared to pass off as it would from sand; this I confess surprised me, as the residuum from every saline water I have before examined, particularly those of Ballston and Saratoga, which are so similar, suffered a considerably greater diminution from the action of alkohol.

The matter which now remained on the filter after the action of alkohol, weighing 70½ grains, was digested for some time, in a sufficient quantity of distilled water, till a complete solution of whatever salts it contained, had taken place. It was then filtered, and a light brown powder remained on the filter, which, when dried, was found to weigh exactly 6½ grains: so that the aqueous solution contained 64 grains; this powder weighing 6½ grains, which resisted the action of alkohol, and was insoluble in eight times its weight of distilled water, could have been nothing more than carbonat of lime or carbonat of magnesia combined with the small quantity of iron, held in solution by carbonic acid gas. It become necessary now to examine it, and to determine not only its contents but the proportion of the ingredients; for this purpose I poured on it, by degrees, a sufficient quantity of dilute marine acid, till the whole of it was dissolved with effervescence. As it was evident that the iron which was suspended by the carbonic acid, in one pint of the water, was now held in solution by the marine acid, I made use of succinate of ammonia, as the most successful method of collecting it, separately, preferring this to ammonia, which precipitates magnesia also. By proceeding in this manner, a brown precipitate was thrown down, which consisted of succinate of iron, and by calcining this in a dull red heat, I obtained one grain of oxyd of iron. The solution in marine acid, being thus deprived of the whole of the iron, there remained 5½ grains of carbonates of lime or magneisa. To separate them, I gradually poured on a few drops of pure ammonia, till the whole of the magnesia was thrown down, which when collected and dried, I found amounted to only 1½ grains; the remainder, by examination with oxalate of ammonia, proved to be carbonat of lime. From these experiments therefore, it appears, that the residuum which resisted the action of alkohol and was insoluble in distilled water, consisted of

Carbonat of Lime, - - -	4 grains,
Carbonat of Magnesia, - -	1½
Carbonat of Iron, - - -	1
	6½

We have now only the aqueous solution to examine; this, which consisted of 64 grains, after the earths had been thrown down, and the whole residuum had been submitted to the action of alkohol, I proceeded to evaporate slowly in a glass vessel; as the process went on beautiful cubic crystals appeared; it was then evaporated to dryness, when 64 grains of a saline substance was obtained, which was examined in the following manner:

Experiment 1. On a part of it a few drops of sulphuric acid were poured, and heat being applied, fumes instantly arose, which had the peculiar smell and other properties of muriatic acid.

Exp. 2. A small quantity of this salt was again dissolved in a wine glass of distilled water, and to this were added a few drops of nitrat of silver, when an immediate dense white precipitate was thrown down.

Exp. 3. A little of this salt was dissolved in another glass of water, when a few drops of muriat of barytes were poured in, without producing any change.

Exp. 4. To a small quantity of this saline solution, a few drops of oxalate of ammonia were added, without altering its transparency.

Exp. 5. Paper stained with turmeric, when immersed in a solution of this salt, was immediately changed, to a very dark brown color.

Exp. 6. Blue litmus paper, stained red, by vinegar, had its blue color immediately restored, when dipped in a solution of this salt.

The aqueous solution which consisted of 64 grains, having been thus examined, it appears by experiment 1, 2, 3, and 4, that it contained no other salt besides muriat of soda, but it also appears from experiments 5 and 6, that it contained an alkaline carbonat which previous experiments had detected. We have already shown that one pint of this water contains 5 grains of carbonat of soda, and as this enters into solution with the muriat of soda, it is necessary to deduct these 5 grains from the 64 grains, which the aqueous solution contained; we shall then find that one wine pint of the Albany water contains,

Muriat of Soda, - - - -	59 grains.
Carbonat of Soda, - - - -	5

The analysis of this water having been thus completed, I shall now state the result of the inquiry, and recapitulate the contents of the different ingredients which have been found in one wine pint of the water, as follows :—

Muriat of Soda, - - - - -	59	Grains.
Carbonat of Soda, - - - -	5	"
Carbonat of Lime, - - - -	4	"
Carbonat of Magnesia, - - -	$1\frac{1}{2}$	"
Carbonat of Iron, - - - - -	1	"
Muriat of Lime, - - - -	$\frac{1}{2}$	"
Total,	71	Grains.

Carbonic acid gas in one pint—26 cubic inches.

It now remains only to make a few observations, on the striking resemblance between this mineral water at Albany, and those of the different springs at Ballston and Saratoga. Having taken great pains to make an accurate analysis of the contents of the different springs, at each of those places, the result of which I have already given to the public,* it may

* Vide, An Experimental Enquiry into the Chemical Properties and Medicinal Qualities of the Principal Mineral Waters of Ballston and Saratoga, by Wm. Meade, M. D. Published at Philadelphia.

on this occasion not be uninteresting to pay some attention to the comparative qualities of each. Having no theory to support, and feeling no particular interest in the question of the merits of any of them, I may perhaps be brought to consider the subject with fewer prejudices than others.

In stating the component parts of each, I shall give the results of my own analysis, which as it was performed with great care, and has been long before the public, I feel myself responsible for. The principal springs to which I shall refer, are the Congress spring at Saratoga, the public well at Ballston, and the Albany spring lately discovered.

The following are the contents of each by analysis in one pint of water.

Congress Spring.	Grs.	Public Well, Ballston.	Grs.	Albany Water.	Grs.
Muriat of Soda,	51 1-2	Muriat of Soda,	21	Muriat of Soda,	59
Carbonat of Lime,	13 3-4	Carbonat of Lime,	4 5-8	Carbonat of Soda,	5
Carbonat of Magnesia,	8 1-2	Carbonat of Magnesia,	5 5-8	Carbonat of Lime,	4
Muriat of Lime,	1 3-4	Muriat of Lime,	1 3-4	Carbonat of Magnesia,	1 1-2
Muriat of Magnesia,	2 1-2	Muriat of Magnesia,	3-4	Carbonat of Iron,	1
Oxyd of Iron,	1-4	Oxyd of Iron,	1-2	Muriat of Lime,	1-2
Total	78 1-4	Total	34 1-2	Total	71.
Carbonic acid gas, Cubic Inches,	33.	Carbonic acid gas, Cubic Inches,	30 1-2	Carbonic acid gas, Cubic inches,	26.

The first circumstance which I shall remark with regard to all these waters is, that they contain no neutral salts except muriat of soda, but that in the quantity of this they differ materially, whilst the Ballston water contains only 21 grains in a wine pint, the Congress spring contains $51\frac{1}{2}$ grains, and the Albany water, 59 grains. But the most essential difference between these waters arises from the quantity of earths which are held in solution by carbonic acid gas; while the Congress spring contains in one pint $22\frac{1}{2}$ grains of carbonat of lime and magnesia, the Albany water contains only $5\frac{1}{2}$ grains. There is also another material difference between these waters. In none of the springs either of Ballston or Saratoga have I observed an alkaline carbonat, nor indeed could it be expected, as the presence of carbonat of soda is incompatible with either the muriat of lime or of magnesia which I have found in them, but having found five grains of carbonat of soda in the Albany water, it entirely accounts for not finding either of these muriats in it, as they cannot exist together, for I consider the half grain which was taken up by the alkohol owing either to a small quantity of water which the alkohol contained, or else that it was rather the product of close evaporation than as a component and original ingredient in the water.

With respect to the carbonat of iron, which is found, in greater or less quantity, in all those springs, the Albany water appears to contain more than any of them; while the Congress spring is not rated at one grain in the quart, the Albany contains one grain in a pint. I am aware that the analyses of others have stated the iron as much more than I do, but on a reference to the waters of the most celebrated chalybeates in Europe, I find that none of them are rated as containing half this quantity, though analyzed by chemists of undoubted skill and science, and I am satisfied that if I have erred on this occasion, it is in rather stating the amount above the real quantity.

In no one quality is the analogy between these springs more striking than in the quantity of carbonic acid gas which each of them contains; a reference to the synoptical table will show that they do not differ essentially, and yet I would not have it understood, that the statement of the quantity will be always found precisely accurate, as there is nothing upon which a chemist is more liable to error, so many circumstances being required to insure a uniform result; above all, it is necessary that experiments should be made immediately at the spring. In stating the quantity of carbonic gas, with which all these saline waters are impregnated, it is the generally received opinion, that the whole of it is in a free state, that is, that it is combined with the water, without the intervention of any other substance. A little reflection, however, will show that this is not the case. Although experiments with litmus paper certainly show that this gas gives the water acid properties, yet the greater part of this gas which we afterwards collect, has been combined with carbonats of lime and magnesia, which were held in solution by it, but the union being only slight, the gas being volatile is expelled either by heat, or exposure to the atmosphere, when the earths are precipitated. It is those earths which repress the effect of the acid in the water, while they are combined with it; otherwise the water would have the same lively and sparkling appearance that the Seltzer and Pyrmont waters have, where the gas forming no carbonats, and consequently being in a free state, these waters show quite a different appearance. This is fully exemplified in the artificial soda water, where no earths are made use of, and where the carbonic acid gas is in a free state, combined with the water by atmospheric pressure.

With respect to the medicinal qualities of this water, I must refer for a full account of them to the work on this subject which I have before mentioned; feeling that this Journal is more particularly confined to other subjects. But it has been frequently asked, which of these waters is the most valuable? To this the obvious answer is that as they differ essentially in the quantity and quality of their contents, so should they be recommended according to the different diseases and constitutions to which they are adapted. As the waters of the Congress spring and of Albany differ but little in their saline contents, and are endowed with the same cathartic qualities, they seem adapted to become suitable remedies in the same complaints, while the waters of Ballston containing a much less quantity of saline ingredients, and still possessing the valuable properties arising from the impregnation of iron and carbonic acid gas, they seem to be possessed of equal tonic power, and are equally valuable when cathartics* are not necessary or are injurious.

As the Congress spring contains a quantity of carbonat of lime and magnesia, so vastly exceeding that which we find in the Albany water, it becomes a question to consider whether it renders it, in a medical point of view, more valuable. If I were to give my opinion, I should say not; on the contrary, when it is recollected how many pints of this water are frequently taken daily by invalids, it may be doubted whether so much of these carbonats is not injurious to the stomach, while the water at Albany, containing nearly the same proportions of carbonat of soda as of lime and magnesia, no injurious effects can be produced by the use of it. I shall now add only one remark, in which all judicious physicians will agree, and this is, that whatever benefit may be expected from the use of this or any other mineral water, can be obtained only by a moderate and steady perseverance in drinking it, and not as is very frequently the case, by a too free use of it for a short period.

* At the time of Dr. Mead's analysis, the spring under the bath house at Ballston, had not been discovered.

INTELLIGENCE AND MISCELLANIES.

I. *Foreign Literature and Science, extracted and translated by* Prof. J. Griscom.

1. *Prussia. Public Instruction.*—There are in all the Prussian Monarchy, 20,085 elementary Schools for the people, of which 2,462 are in the towns, and 17,623 in the country. 21,885 masters are attached to these schools, of this number, 15,795 are Protestant and 6,090 Catholics. The sum employed annually by the government in the maintenance of these Schools amounts to 2,352,752, rix dollars, (about 1,880,000 dollars.) The mean annual assessment for the support of these masters, is $150 in the cities and $70 in the country.—*Reveu Enc.*

2. *Iron, varieties of.*—The result stated in a memoir on the different states of iron, by *M. Muller*, of the administration of mines of Prussia is as follows:

I. *Cast Iron.*—1. Iron forms two distinct compounds with carbon: first, a little carbon and much iron, (the protocarburet,) and a second much carbon and a little iron, the graphite, (per carburet.)

2. Cast iron is only a compound of pure iron and carbon; the gray variety contains besides some graphite.

3. In high furnaces the ore of iron begins by being deoxidized; the regulus combines immediately with carbon, and continues to become charged with it as long as circumstances permit. This operation of reduction is accompanied with the formation of dross, which materially modifies the quantity of carbon which the cast iron contains, according to the rapidity or slowness of its formation; its perfect or imperfect vitrification, its liquidity or thickness of consistence, and lastly the nature of its constituent parts.

4. In the cast iron, which has but little carbon, the affinity of the iron for this substance is too strong to allow it to separate, and form graphite. This variety remains white even when it cools slowly.

In the varieties which are rich in carbon, this substance, on the contrary, separates during the solidification of the metal, in forming graphite, whose particles by an intimate mixture with the rest of the mass, give to the cast iron the gray fracture.

A sudden cooling not permitting the successive formation of graphite, always occasions a white fracture.

5. There are substances which, united to iron, prevent this separation of carbon, under the form of graphite, such as phosphorus, sulphur, the metallic bases, earthy oxides, &c. and other metals especially manganese. In this case, the cast iron which contains as much or more carbon than the greyish variety, preserves the white fracture even after it has been cooled as slowly, and as carefullly as possible.

II. *Pure Iron. Forged Iron.*—Forged iron is considered as pure iron containing foreign substances, (especially carbon,) in too small quantities to alter its properties. The different varieties depend on the properties, more or less injurious, which these substances communicate.

III. *Steel.*—Its chemical composition appears to be identical with that of white cast iron, that is to say it is formed of pure iron, carbon and a third body, such as aluminum, silicium, manganese, &c. &c. which renders stable the union of the carbon and the iron. The difference between white cast iron and steel, appears to reside according to M. Muller, only in the mechanical arrangement of the molecules.—*Annales des Mines*, *Tome* 13, 1826.

3. *Astronomical Observatory.*—His Majesty the King of the Netherlands whose munificence in the encouragement of public instruction, is constantly active, has just given a new Ordinance for the establishment of an Observatory at Brussels. The Regency of the city with a view to second so honorable a project, has asked permission to share in the expences of its erection and has offered a site in one of the most beautiful quarters of the city. The care of preparing the plan has been confided to M. A. Quetelet, professor of Mathematics and Astronomy at the Museum, and who is to be associated with M. Walter, Inspector General of public instruction.

They are also occupied at Brussels, at the present time, in the formation of a vast Botanic garden, destined, principally to favor the progress of horticulture. The purchase of the ground which is situated in the vicinity of the projected observatory, has been made by shares, or stock, the interest of which will be paid by means of 12,000 florins, (more than 25,000 francs,) which are insured annually to the establishment by the government and the city of Brussels. One of the principal stockholders is *M. Drapier*, advantageously known by various scientific publications.—*Rev. Enc. August*, 1826.

4. *Powder Mills.*—Although great care is taken to exclude from these manufactories all articles of iron, and to substitute copper and other metals, in the metallic parts of the machinery, which will not strike fire, yet it is well known that explosions, attended with disastrous consequences, are very frequent. Excited by an occurrence of this nature, *M. Aubert*, Col. of artillery, was induced, in conjunction with Capt. *Tardy*, to resume some experiments which he had unsuccessfully tried, to ascertain, whether gunpowder would not explode by the shock of copper. The result of these renewals was that powder would inflame by the stroke of copper upon copper, or upon the alloys of copper. This gave rise to further investigations, in presence of the committee of safety, and it was ascertained that gunpowder could be exploded by the stroke of *iron* upon *iron; iron* upon *copper; copper* upon *copper; iron* upon *marble;* and by using the balistic pendulum, by *lead* upon *lead;* and with suitable precautions even by *lead* upon *wood.* The experiments were successful both with English and French powder. The experiments most clearly show, that in all the manipulations of a powder manufactory, all violent shocks and percussions should be carefully avoided, since they may occasion the disengagement of sufficient heat to produce the inflammation of powder.

Bul. d'Encouragement, Juin, 1826.

5. *New Phenomena of Vapour*, observed by Clement Desormes.—This philosopher communicated, on the 4th of December, to the Royal Academy of Sciences, some singular results relative to steam. When compressed in a boiler, and issuing in a violent and hissing jet, through an orifice made in a pretty large plate of a flat disk, if metal be presented to it, at a little distance from the orifice, the disk is strongly repelled; but if it be brought near and placed against the plate, as if to close the orifice, although the steam issues on all sides

like artificial fire works, and presses against the disk more than before, not only is the disk not driven away, but it adheres to the plate even when the jet is directed downwards. It remains suspended in opposition to its gravity, and can be detached only by force. The same result takes place, in an experiment with the wind which issues from the large bellows of a furnace.

Another fact, also curious, though already well known, is, that a current of steam from a boiler in which it is very hot and much compressed, seems like a cool wind compared with a current at one half the temperature and at one twentieth of the pressure.

From his first experiments, M. Clement concludes that common safety valves, which consist of real disks placed upon openings in flat plates, present a danger, inherent in their form. Scarcely are they raised, so as to allow a thin plate of steam to escape, before it becomes impossible for them to rise higher, and if the production of vapour is too considerable for the small opening which may have obtained, and for the strength of the boiler, an explosion may take place, though the safety valve is open. This is in fact what sometimes happens, and which has hitherto appeared incredible. M. Clement had not time to give a full explanation of these singular phenomena. We only know that he attributes them to the vacuum which takes place in the current of steam, in consequence of the extreme swiftness of its particles, and of the conical form the current assumes between the adjacent plates. The current, from its great force is so expanded towards the borders, as to become much less than the pressure of the atmosphere, which acts upon the moveable disk forcibly enough to resist the vapour.

The remedy for this danger is a good proportionate space between the orifice and their borders. The first should be large and the others small. Besides, the addition of a conical tube to the safety valve, would diminish the effect of atmospheric pressure, and of the weight with which they are loaded. M. Clement thinks that experiment alone can determine what is the best modification of safety valves to remove the danger he points out, and which has been so long unnoticed. He wishes the manufacturers to make the necessary trials, agreeably to the theory which he has given.

Idem.

6. *Preparation of Blacking*, by M. Braconnot.—Take of plaister, ground and sifted, one kilogramme (2 lbs. 4 oz.); lampblack $2\frac{1}{2}$ hectogrammes, (about 9 oz.); barley malt, as used by brewers, 5 hectogrammes, (18 oz.); olive oil 50 grammes, (1 oz.)

Steep the malt in water, almost boiling hot, until the soluble portions are well extracted; put the solution into a basin, stir into it the plaister and lampblack, and evaporate to the consistency of paste; then add the oil, the quantity of which may be increased by degrees. To the mixture may be added, if desired, a few drops of oil of lemons or of lavender, as a perfume. If ground plaister be not attainable, its place may be supplied with potter's clay.

This is undoubtedly the cheapest and finest blacking; it spreads evenly, dries and shines quickly on the leather by a slight friction of the brush and has not the objection of burning the leather.—*Bul. D'Encour. Mars*, 1825.

7. *Preservation of alimentary substances, by the process of* M. Appert.—The success which attended the method employed by *Appert* in the preservation of even the most delicate and highly flavoured animal and vegetable substances used in cookery, induced the minister of the interior about 17 years ago to reward the author with a premium of 12,000 francs. The process then employed was confined in its operation to vessels of small dimensions, the multiplicity of which would too much encumber a ship, and the number of boxes to be opened at each repast would be too troublesome. On this account the Society of Encouragement proposed, in 1822, a premium of 2000 francs to any person who should preserve at least 2 lbs. of animal substance in each vessel during the space of a year; in which time the said preparations were to cross the line. One or two boxes were to be opened at the time of embarkation or prior to crossing the equator; and the others on their return to France, to be sent to the Society, all properly attested under seal of the authorities at the place of embarkation. The competitors were also to prove by their registers, that they manufactured and sold annually, to the amount of 20,000 francs, substances preserved by the same or a similar process. In 1824, two candidates appeared for the premium, viz. *Appert*, of Paris, and *Collin* of Nantes. The former has more than fulfilled the conditions of the premium. He produced two boxes, the first containing

4 lbs. of beef, and the second 3 or 4 lbs. of jelly obtained from meat and poultry, slightly aromatic, and intended as a substitute for the common dry portable soup, but under the form of a very thick jelly. This aliment was put up on the 15th of April, 1822, and opened on the 15th of March, 1824, several members of the Society being present, together with captain *Freycinet*, who was invited to attend. When the boxes were perforated, a slight hissing was heard, owing to the rapid influx of air to supply the place of that which had been absorbed. When opened, the smell of meat was rather strong, but this was speedily dissipated, and nothing remained but the savour of freshly cooked meat. The gravy was sweet and agreeable, the fat firm, and of a good color. The box of jelly was also in perfect condition, with only a very slight savour, which cooks call a burnt taste. The boxes were of tinned iron, and varnished. M. *Appert* proved by his register, that he had sold more than 100,000 francs worth of his preparations annually. Captain *Freycinet* attested that he had used M. Appert's preserved aliments in his long voyages, to the evident preservation of his crew from various maladies which might have cost him the lives of many men. This brave and learned navigator expressed the earnest hope that the whole marine might in time be supplied with provisions thus prepared, in lieu of salted meats. The premium of 2000 francs was decreed to M. *Appert*.

Bull. de la Soc. d'Encour. Oct. 1824.

Note.—At the termination of the Chemical Lectures in Rutger's Medical College two months ago, I opened a box of meat containing about 4 lbs. which was given me by the late lamented Captain Williams, of the Albion, and which had been in my possession more than 7 years. It had been put up by a manufacturer in England, agreeably to the method of *Appert*. This box was of common, but stout, tinned iron, the cover thoroughly soldered on, and varnished. On perforating the box with the corner of a small chissel, the air entered with a hissing sound. The contents proved to be veal cooked and put up with pieces of boiled carrot intermingled with jelly, the whole free from all unpleasant taint, and in good condition. Toward the close of the lecture the materials were dressed in a stew pan, by my assistant, and at the conclusion of the lecture, this food, which had been cooked at least seven years before, was partaken of by a great number of the class, who pronounced it good, and free from all taint of putridity. A portion of it was served upon my table several days after; and though is was less juicy than meats fresh from the market, it was quite palatable. The facts appear to warrant the conclusion, that in the entire absence of air or oxygen in the gaseous form, animal substances may retain their characteristic qualities for an indefinite period. J. G. *5th Mo.* 1827.

8. *Education in Hungary.*—The Catholic population of Hungary amounts to about seven millions, and it appears that in 1824, the number of students which frequented the latin schools were 21,540. Of the Reformed Religion, the population is about 1,500,000 and the number of latin scholars 7,200. Of Lutherans, the population is 700,000, and the number of students 3,800; making the whole number of Catholic and Protestant students in Hungary, exclusive of those of the Greek ritual, about 32,000.

In general, there is no village in Hungary destitute of a school, and it is very rare that any person is found, either Catholic or Protestant, that cannot read. This observation does not apply to the peasantry of the Greek church, who, however, constitute only one eighth part of the population of Hungary.

From these facts one may judge of the correctness of the Edinburgh Review, republished in the following terms in an article of the *British Review:* "Almost all the inhabitants of Hungary, Transylvania, Croatia, and Bukowina, are unable either to read or write." The heedlessness of men who declaim against the ignorance of others, while they are themselves ignorant of the beings they are speaking of, is certainly to be pitied.—*Rev. Ency. Mars*, 1827.

9. *M. De Fellenberg*—has founded near Meykirch, two leagues from Bern and Hofwyl, a colony formed of twelve boys of the age of twelve to fifteen, to whom has been given the name of the little Robinsons, and who present in miniature, an image of the life and employments of the clearers or settlers upon new land in the woods of North America. These pupils, taken from the school of Vehrli, are directed by *Pfiffer*, a young countryman of the canton of Glaris. A few farming implements, some provisions, and two goats, composed, at first, all the wealth of the little colony; their domain consisted, last spring, of a small piece of uncultivated ground, upon the side of a hill, crowned by a wood of pine, with a miserable hovel, which simply afforded them a shelter, and was entirely unfurnished with goods or utensils. Here the little colonists established themselves in the month of March 1826. The colony has already the aspect of a little farm, and satisfaction sparkles in every eye; they do not refuse the occasional assistance of their old companions at Hofwyl, and the Count *Capo d' Istria*, who visited them a short time before I did, made

them a present of a cow, which was received in triumph. A cordial emulation animates them; the greater portion of them read correctly and know Robinson by heart. It was feared that in such an exile, the little pioneers would regret the comforts and varied occupations, amusements and advantages of *Hofwyl;* far from this, they prefer their poor and wild *Robinsoniere*, as the place is surnamed. They are proud of witnessing the effects of their own industry, and enjoy at once what they have accomplished, and what they have in anticipation.

Oh that it were in my power to bestow upon France such a school of poor children as that of Hofwyl. A good teacher is the soul of it; but nature is avaricious of such men as M. de Fellenberg, and Vehrlis are not produced at pleasure; much time is necessary for a young man to be informed of all that is important to know, in order to become duly penetrated with the wholesome and fruitful ideas, with the modest, mild, persevering and religious sentiments which are requisite to the functions of a teacher of the poor.—*M. De B. Idem.*

10. NECROLOGY. De La Place, (Piere Simon,) *Peer of France, Member of the Institute, Academy of Sciences, died at Paris, March* 5, 1827.—Science and Letters have just sustained a grievous loss. M. De la Place has yielded to a malady, which it was hoped would have terminated favorably, but neither the assistance of art, skilfully employed, nor the attentive cares of a beloved wife, could arrest the progress of a disease which fastened itself upon the debility produced by age. His friends and illustrious confederates accompanied his remains to their last abode, and scattered a few flowers upon his tomb. The Academy of Sciences has lost its greatest ornament; and the sceptre of astronomy, physics, and mathematics has fallen from the hands which were so worthy of bearing it. Let us hope, nevertheless, that it will not depart from France, and that one of the celebrated compeers of our great academician will be judged capable of receiving it. The art which he so well possessed, of treating profound subjects with elegance and clearness, had gained for him the suffrages of men of letters, and the French Academy, over which he presided, feels all that it has lost, though it has found a worthy successor to the illustrious deceased in M. Fourier. All the governments which have succeeded each other in France, have in their turns, been well aware of the im-

portance of honoring De la Place, and they accordingly raised him to public dignity. After the Restoration, the king confirmed the decision by naming him to the peerage, the duties of which never diverted him from those learned researches, in which death alone could arrest his progress. His last years produced sparks of that fruitful genius which old age had no power to chill. He honored all those who cultivated science, and granted to such his encouragement and counsel. He employed the credit which his vast fame and his public employment gave him, only in assisting men who showed a taste for study; and all his life was employed in favoring learned men and in extending the bounds of science. We propose to give an extensive notice of the labors and discoveries of this celebrated man, so worthy of holding a distinguished place in the memory of our descendants.—*Francœur. Idem.*

11. *La Rochefoucauld—Liancourt.*—(François Alexandre—Frederic, Duke of,) peer of France. member of the institute, died at Paris, March 27th, 1827, at the age of 81.

The sacred cause of humanity is daily losing some of its supporters and defenders. The entire life of this venerable philanthropist has been a succession of good actions, and of services rendered to his country. He introduced vaccination into France and ceased not during more than twenty years, to propagate it with indefatigable zeal. He founded the schools of arts and trades, of Compiegne, of Chalons and of Augers. He presided at the creation of the conservatory of the arts and trades of Paris. Hospitals, and prisons whose interior discipline he contributed greatly to ameliorate, and the greater number of the establishments devoted to indigence, old age, and misfortune, have by turns been objects of his active beneficence. He was also the principal founder of the school of mutual instruction in our country; and the two societies for the amelioration of elementary instruction, and for the application of christian morals to the relations of social life, were established under his auspicies, and in a great measure by his exertions. He has been a powerful agent in the promotion of industry in the legislative chambers, in the society for the encouragement of national industry, and especially in the commune of Liancourt, where his lessons and example have given a salutary impulse to the whole country. The ferocious enemies of new institutions and public liberty have not spared this excellent man, always superior to all the influences which would violate his conscience or restrict his love of beneficence. Obliged to give up more than six gratuitous posts which he honored by his virtues, he felt very forcibly the pain of being separated from the unfortunate beings whom he cherished as his children.

The funeral of the Duke de Liancourt was celebrated on the 30th of March, at the church of the Assumption. A numerous concourse of the peers of France, and of deputies and distinguished men of all classes of society attended the ceremony. But in the midst of the solemnity and of the general grief, a sacriligeous profanation occurred which filled every heart with indignation and pain. A number of pupils of the school of Châlons who attended the procession, wished after obtaining the consent of the family, to bear the coffin which enclosed the remains of their benefactor and father. No law, no public ordinance was infringed by this popular homage, equally honorable to him who was the object of it, and those who wished to bestow it. But in the mean time, a commissary of police, and a military chief, by force of arms and at the point of the bayonet, tore away the coffin from the dovotion of public gratitude. Citizens were struck, overthrown in the mud, and even wounded; blood was spilt; the coffin fell into the gutter, and was with difficulty replaced upon the carriage!!!

At the barriere de Clichy, when the corpse was placed in a coach to be conveyed to Liancourt, M. Charles Dupin, member of the academy of sciences, pronounced an eloquent discourse, and proved himself the worthy organ of the various feelings which affected the numerous spectators.

The chamber of Peers, in its session of the 31st of March, ordered, on motion of the Duke de Choiseul, that the grand Referendary should be instructed to enquire into the cause of the disorder during the obsequies of the Duke de La Rochefaucauld—Liancourt, and report the same to the chamber.

A life so long, and so well employed, as that of the virtuous citizen whose death we deplore, is worthy of history. We shall present an abridged portrait to the readers of the *Revue Encyclopedique*, on which he often bestowed marks of his regard, as an enterprise of public good, and which he has enriched with various useful communications. We shall take delight in tracing the philanthropic views, the efforts, actions and aim of the life of the man who has done honor to his country and to humanity. The profound sentiment of a perfect agreement between his thoughts and our own, will serve as an encouragement to continue to fulfil the difficult task in which we are engaged, and with which he had deigned sometimes to become an associate.—*Idem.*

M. A. J.

12. *On the action of Alkaline Chlorides as the means of disinfection; in a letter from* GAULTIER DE CLAUBRY, *to* GAY LUSSAC.

[EXTRACT.]

It has appeared to me that after the publication of your memoir on chlorometry, (Ann. de Ph. et de Ch. XXVI, 165,) the action of the chloride of lime was perfectly understood, for you say that "its solution exposed to the air, is by degrees decomposed; a portion of the lime unites with the carbonic acid contained in the air, and the chlorine, which was combined with it, becomes disengaged; this decomposition may be retarded by introducing an excess of lime."

This observation appears to have been overlooked, since M. Labarraque tries to prove that it is the miasmatic substance itself, which is attracted by the chloride, and which becomes decomposed by action on the chlorine which it contains.

Chloride of lime, well saturated, dissolved in water, was subjected to the action of a current of carbonic acid gas; after a few moments, chlorine was disengaged, and by continuing the operation, the whole of that gas was expelled from the combination; the liquid had no longer the power of discoloration, even on the tincture of turnsol; carbonate of lime was precipitated, a portion being afterwards redissolved in the excess of carbonic acid.

This experiment is tedious; the decomposition of a gramme of the chloride required more than three hours, but it was completed at the end of that time. Air which had been passed slowly through a solution of caustic potash, produced no sensible effect on a solution of chloride of lime, during half an hour's continuance; it should be observed however that at the beginning of the experiment a slight crust of carbonate of lime was formed on the surface by the action of the air which filled a part of the apparatus.

The carbonate of lime obtained from the decomposition of the chloride of lime, retains no trace of chlorine. The chloride of soda is decomposed by carbonic acid like chloride of lime only more slowly, because it does not form an insoluble salt.

It is difficult to obtain chloride of lime entirely free from hydrochlorate. I found the quantity of hydrochloric acid to be exactly the same after the action of the carbonic acid as before. To determine the quantity of hydrochloric acid in the chloride before decomposition, I treated the chloride with acetic acid, and precipitated with nitrate of silver.

Simple exposure to the air likewise decomposes the solution of chloride of lime. A filtered solution was exposed on the 13th of August, and on the 10th of October, it would not discolor turnsol; the precipitate when washed, was found to be carbonate of lime. These experiments show clearly enough what takes place when a chloride is exposed to the action of air containing miasmatic impregnations; it appeared to us however that a few direct experiments would not be useless.

Some air was blown through a quantity of blood, which had been abandoned to putrefaction during a week and which emitted an unsupportable odour. The infected air was then passed through chloride of lime; carbonate of lime was formed and the air remained entirely free from smell and completely purified by the chloride.

The experiment was repeated by substituting a solution of caustic potash for the chloride. The air issued from it with a very fetid odour.

Air which had been left twenty four hours in contact with the putrefied blood, was placed in contact with the chloride; the disinfection was complete in a few moments, and carbonate of lime was formed. Another portion was treated with caustic potash, and afterwards with the chloride; but it preserved its insupportable odour!

It appears to us that nothing is at present to be desired with respect to the action of alkaline chlorides as disinfecting agents; the carbonic acid of the air decomposes the chloride, and sets the chlorine at liberty, which then re-acts as if it had been directly employed.

It is thus easy to explain the preference to be given to chlorides as disinfecting substances, over fumigations of chlorine. The carbonic acid in the air, or that which arises from animal decomposition, drives the chlorine from its combinations, and as this action takes place slowly, the chlorine is less susceptible of acting on the animal economy, but decomposes easily the putrid miasmata; it then becomes a true fumigation of chlorine only less strong and much longer in operation.—*Ann. de Ch. and de Phys. Nov.* 1826.

Paris, October 28, 1826.

13. *Magnetism by the Solar Rays.*—It appears from the experiments of A. Baumgartner, Professor of Philosophy at Vienna, that if an iron wire of the size of a common knitting needle, is exposed to the direct white light of the sun, while its surface is partly oxydized, it acquires magnetism. This effect did not ensue when the surface was wholly covered with oxide, nor when perfectly polished. Having heated a steel wire of the size of a knitting needle, so as to cover it entirely with black oxide, he removed, by means of an oiled stone and chalk, portions of the oxid in zones of two or three lines in length, and exposed it to the sun. After some time it was found that the polished places had become so many North poles, while corresponding South poles existed in the unpolished portions. A wire polished at one of its extremities only, acquires North polarity at that extremity, and South at the other. If the middle only be polished, each extremity becomes South, and the middle North. In this manner any number of poles may be developed which the length will admit. A wire 8 inches long will furnish as many distinct poles as inches in length, but of unequal intensity.—*Idem.*

14. *Metallic Refrigerating mixture.*—It is stated by *Dobereiner*, that if 207 grains of lead, 118 grains of tin, 284 grains of bismuth, and 1617 grains of mercury be mixed together at the temperature of 17.5 centigrade, (63.5 Fah.) the thermometer descends to —10 cent. (14 Fah.)—*Ann. de Ch. June*, 1826.

15. *Chinese paper*, of which so much use is now made in Europe, chiefly for copper-plate impressions, is distinguished by its homogeneous texture, its smooth and silky surface, its softness and extreme fineness. It is sold in very large sheets, some of which are 4 or 5 yards long and a yard wide.

The Chinese fabricate their paper from different materials. In the province of *Se-Tschuen* it is made of hempen rags, like the paper of Europe; that of *Fo-Kien*, is made of the young shoots of the bamboo; that of the Northern provinces of the inner bark of a tree called *ku-tschu* which is no more than the paper mulberry, (*morus papyrifera.*) It is this paper which is most commonly employed in China. They resort to chemical solvents, and especially the ley of ashes to bring it to a soft pulp, or paste, and they make use of rice water and other infusions to render it properly consistent and sufficiently smooth and white.—*Bull d'Encour. Juil.* 1826.

16. *Useful Alloy.—M. Frick* in melting together 50 parts of copper, 31.20 of zinc, and 18.75 of nickel, obtained a metallic alloy, white, not oxidable, very ductile, and which acquires a beautiful polish; in varying these proportions, viz. by taking 53.39 of copper, 29.13 of zinc, and 17.48 of nickel, he produced an alloy which has the sound and unchangeable nature of silver, but harder. It is particularly suitable for ornaments, objects of saddlery, boxes, watch chains, &c. This alloy was sold at first at 12 francs per pound, but as nickel is sufficiently abundant in Germany, and as many artists are engaged in this composition the price will necessarily fall.—*Idem.*

17. *Micrometrical observations on Saturn, Jupiter and his Satellites, made at Dorpat, with the large Achromatic Telescope of Fraunhofer*, by Prof. Struve.—After having reduced the measures relative to Saturn and his double ring, to the mean distance of that planet, M. Struve obtained the following values in seconds of a degree, and thousands of a second.

Exterior diameter of the exterior ring, seconds,	40.215
Interior diameter, - - - - - -	35.395
Exterior diameter of the interior ring, -	34.579
Interior diameter, - - - - - -	26.748
Equatorial diameter of Saturn, - -	18.045
Width of the exterior ring, - - -	2.410
———— interior, - - - -	3.915
Interval between the two rings, - -	0.408
Interval between the planet and ring, -	4.352

Professor Struve adds, "I have perceived no other traces of any other subdivisions of the ring. It is surprising that the exterior ring should be sensibly less luminous than the interior.

"The fourth satellite presents a small disk, whose diameter has nearly $\frac{3}{4}$ of a second. I have several times seen the 6th satellite, but never the 7th, which Herschell discovered, during the disappearance of the ring. Schröter doubted the existence of this satellite."

Relative to Jupiter, the observations of M. Struve, reduced to the mean distance of the planet give him

The equatorial diameter of Jupiter,	seconds, 38.442
Polar diameter, - - - - - -	35.645

whence results a flattenning of 0.078, or of $\frac{1}{13.71}$, the first diameter being taken for unity,

Diameter of the first satellite, - -	seconds, 1.018
second, - - -	0.914
third, - - -	1.492
fourth, - - -	1.277

The third satellite has evidently the greatest diameter, while it is very inferior in clearness to all the other satellites, and sometimes appears very pale. The measurements were taken with an amplification of 540 and 600.

Bib. Univ. Oct. 1826.

18. *Mutual Instruction in Denmark.*—M. Abrahamson has just published his third annual report on the progress of mutual instruction, (Copenhagen, 1826.) It is addressed to the King, and brings up the statement to the 3d of December, 1825. It proves that the new method obtains the happiest success in the Danish States. At the end of 1823, the first year of the foundation of schools of mutual instruction, there were in Denmark, 244 schools completely organized. At the end of 1824, the number rose to 605, and on the 31st of December, 1825, there were 1143 schools, in full activity, independently of 564 others in which preparation was making for the introduction of the system. It may then with certainty be foreseen, that at the end of this year, (1826,) there will be in Denmark, more than 1700 schools completely organized.—*Rev. Ency. Oct.* 1826.

19. *Separation of Iron from Manganese.*—M. Quesneville, *fils*, proposes to separate these metals from each other, by adding to their solution arseniate of potash, after having rendered it as neutral as possible, and after having brought the iron to the maximum of oxidation. The iron alone separates in the form of arseniate, and the manganese remains in solution.—*Jour. de Pharmacie.*

20. *Action of anhydrous sulphuric acid on fluor spar.*—M. Kuhlman, Professor of Chemistry at Lisle, has discovered that fluor spar cannot be decomposed by anhydrous sulphuric acid. This new fact is in favor of the opinion which considers this body as a fluoruret of calcium.

Ann. de Chim. et de Phys. Fev. 1827.

21. *Disinfection of Alcohol.*—According to the experiments of M. Accaric, confirmed by those of M. Chevallier, alcohol which has been employed in the preservation of animal matters, is easily disinfected by adding to it, small quantities of chloruret of lime, until the putrid odour has disappeared. It is then to be distilled, and the product may serve for the preservation of new substances, or for any other use in the arts.

Ibid.

22. *Mosaic Gold*, by Parker and Hamilton.—The patentees employ equal parts of copper and zinc, melted at the lowest temperature at which copper will fuse; and after having stirred the mixture so as to produce a perfect combination, they add a fresh quantity of zinc in small portions, until the alloy acquires the requisite color. If the temperature of the copper is too high, a portion of the zinc will be volatilized and the result will be the mixture called strong solder, but if the operation be conducted at a temperature as low as possible, the alloy assumes a yellow color like brass, and then by adding zinc in small portions the color changes to purple, violet, and finally becomes perfectly white. This alloy may be cast into ingots, or any other form, and when cold it presents the aspect of an alloy of fine gold and copper. But it is difficult to preserve this color when remelted as the zinc is easily volatilized if the heat be raised above the melting point of copper.—*Bull. Univ. Dec.* 1826.

23. *Solution of Copal.*—Many persons do not know that the tedious process of dissolving copal in spirits of wine, becomes at once easy and expeditious by the addition of camphor: thus, dissolve one ounce of camphor in a quart of alcohol; put the solution into a suitable glass and add eight ounces of copal in small fragments, place the mixture on heated sand, whose temperature should be so regulated that the bubbles which rise from the bottom may be counted as they rise, and let it thus remain till the solution is complete.

This process will dissolve more copal than the liquid will contain when cold. The most economical method is to put the vessel aside for some days and when the solution is effected, to decant the clear varnish and leave the rest for a second operation.—*Ibid.*

24. *Pyrolignous acid.*—Agreeably to the experiments of Berzelius, detailed in the transactions of the Royal Academy of Sciences at Stockholm, every trace of empyreumatic oil may be removed from this acid by animal charcoal. It is only necessary to mix the charcoal with the acid and filter immediately. The charcoal which remains in the process of making prussian blue was found to be very efficacious, even in exceedingly small quantities.—*Bull. Univ. Juillet*, 1826.

25. *Crystallization of Camphor*, by M. John.—I have observed that the vapours of camphor, which are spontaneously developed in the course of a few years in a glass well closed and containing camphor wrapped in paper, crystallize in small tables with six faces, of which the two which are opposite are larger than the four other faces. The crystals are transparent and very brilliant.—*Bull. Univ. Mars*, 1826.

23. *Animal Magnetism.*—A volume on this subject entitled, Lettres physiologiques et morales sur le magnetism animale, contenant l'exposé critique des experiences les plus récentes et une nouvelle theorie sur ses causes, ses phénomenes et ses applications à la medicine, &c. par J. Amedée Dupau, D. M. 1 vol. 8vo. was published in Paris in 1826, in the form of letters addressed to Professor *Alibert*. The spirit which has directed the author, in these letters, is that of doubt and examination, the only sure guide to the truths of science. Without troubling himself with vain denominations, M. Dupau has enquired by researches into the mysteries of ancient temples, and the magical secrets of the middle ages, whether all the physical and moral phenomena, which certain practises determined, were not owing to the same cause and belonged not to the same series of facts. The author has sought to demonstrate, not that animal magnetism is nothing, but that it is a different thing from what the magnetisers suppose: he shows that magnetic phenomena have existed at all times, and that they present themselves to the ob-

servations of medical men in various nervous and mental diseases. From all the facts before him, the author deduces the following conclusions:

1. That magnetic effects are only nervous diseases under the form of convulsions, extatic delirium, comatose sleep, somnabulism, &c.

2. That magnetism developes these cerebral neuroses only in persons predisposed to these affections.

3. That magnetism is a dangerous process, since it tends to favor the developement of these diseases.

4. That magnetism is still more dangerous in its moral relations.

Such are the principal results of this work, which by its mass of facts, and the novelty of its views must very much contribute to extend a knowledge of the nature of animal magnetism.—*Bull. Univ. Mars*, 1826.

27. *Preparation of Soda from the Sulphate of Soda.*—Dissolve, with or without heat, lime or calcareous matter, in pyrolignous acid; the liquor becomes covered with the vegetable oil which this matter contained, and which can be mechanically separated; dissolve in the liquor thus saturated with lime, a quantity of sulphate of soda, determined by the degree which the calcareous solution indicates on the hydrometer for saline solutions, (pèse-sel.) By this procedure, the sulphuric acid quits the soda, and forms with the lime a solid salt which precipitates to the bottom of the containing vessel. The supernatant fluid, evaporated and crystalized, gives acetate of soda. This salt, collected dried, and calcined, either on the hearth of a reverberatory furnace, or in front of a furnace adjusted for the purpose, gives carbonate of soda, which a warm ley, on cooling, reduces to the state of crystals, of the greatest purity.—*Ibid.*

28. *School of Arts.*—Major General Martin, a Lyonese, who died 25 years ago in Bengal, left to the city of Lyons 250,000 rupees, (1,200,000 francs,) on condition that the interest should be applied to an institution which should be acknowledged to be the most useful for the public good in his native city. The institution is to be called the *Martinière.* The royal academy of Lyons decided on the 10th of December, that the Martinière should be a gratuitous school of arts and trades, especially applied to the progress and

perfection of Lyonese industry. M. Tabareau, member of the academy of Lyons and professor of Philosophy has been placed at the head of the course of instruction, and has been directed to repair to Paris, in order to become acquainted with the course professed by Baron Dupin; and thence to Chalons-sur-Marne, to learn the organization of the royal school of arts and trades at that place. The instruction will be theoretical and practical. The theory will embrace grammar, arithmetic, drawing and designing, architecture, notions of algebra, elementary and descriptive geometry, and their applications to the arts, a course of chemistry, applicable especially to dyeing, and a course of machines. The principal shops attached to the school, shall be those of joinery, lockmaking, turning in wood and metals, casting, machinery and silk dyeing.—*Ibid.*

29. *Battle of Ants; by* M. Hanhart.—The author in this memoir describes a battle which he saw between two species of ants; one the *formica rufa*, and the other a little black ant, which he does not name, (probably the *fofusca.*) In other respects there is nothing new on this subject, this kind of combat having been described in detail, and in a very interesting manner, by M. Huber, (Recherches sur les mœurs des Fourmis, 1810,) a work to which we refer, not being able here to enter into the requisite details.

M. Hanhart saw these insects approach in armies composed of their respective swarms and advancing towards each other in the greatest order. The *formica rufa* marched with one in front on a line from nine to twelve feet in length. flanked by several corps in square masses composed of from twenty to sixty individuals.

The second species, (little blacks,) forming an army much more numerous, marched to meet the enemy, on a very extended line, and from one to three individuals abreast. They left a detachment at the foot of their hillock to defend it against any unlooked for attack. The rest of the army marched to the battle, with its right wing supported by a solid corps, of several hundred individuals, and the left wing supported by a similar body of more than a thousand. These groups advanced in the greatest order, and without changing their positions. The two lateral corps took no part in the principal action. That of the right wing made a halt and formed an army of reserve; whilst the corps which marched in column on the left wing manœuvered so as to turn the hostile army, and advanced with a hurried march to the hillock of the *formica rufa*, and took it by assault.

The two armies attacked each other and fought a long time without breaking their lines. At length disorder appeared in various points and the combat was maintained in detached groups; and after a bloody battle which continued from three to four hours, the *formica rufa* were put to flight and forced to abandon their two hillocks and go off to establish themselves at some other point with the remains of their army.

The most interesting part of this exhibition, says M. Hanhart, was to see these insects reciprocally making prisoners, and transporting their own wounded to their hillocks. Their devotedness to the wounded was carried so far, that the *formica rufa* in conveying them to their nests, allowed themselves to be killed by the little blacks without any resistance rather than abandon their precious charge.

From the observations of M. Huber, it is known that when an ant hillock is taken by the enemy, the vanquished are reduced to slavery, and employed in the interior labors of their habitation.—*Bull. Univ. Mai.* 1826.

29. *Action of Barytes, Strontian, Chrome, &c.; by* C. G. Gmelin.—Experiments made upon animals have furnished the following results.

1. Bodies similar to each other in their chemical properties may have a very different action upon the animal organization, such are barytes and strontites.

2. Muriate of barytes, oxide of uranium and oxide of palladium, coagulate the blood when they are injected into the vessels of circulation. These three metals are the only ones which produce this phenomenon.

3. Chromate of Potash applied to the cellular tissue acts upon the bronchia, and augments the secretion of saliva, which becomes thick. It produces only inflammation of the conjunctiva.

4. The oxide of osmium acts upon the stomach, produces vomiting and excites in the lungs the exudation of a serous liquid.

5. Sulphate of magnesia, injected into the vascular system, acts evidently upon the face, producing inflammation, and

increasing the secretion of bile to such a degree, that the large vessels even are colored yellow by it.—*Ibid.*

30. *New Agricultural and Manufacturing Establishment in France.*—The king has directed the purchase and addition to the domains of the crown, of the territory de Grignon, at the price of about a million. It will be placed at the disposal of a stock company who will manage the concern so as to derive the greatest advantages from the soil, agreeably to the most judicious procedures. They will receive 300 pupils who will be taught the theory and practice of agriculture, horticulture, the economy of farming, and the art of deriving by means of various fabrications, the greatest possible advantages from the productions of the soil. The shares are 1200 francs each; the society is chartered for 40 years; the king takes 400 shares, and abandons the profits, which are to be applied to the increase of the establishment, and to the diminution of the pension required from the pupils.—*Ibid.*

31. *Chlorate of Lime.*—M. Lemaire states that a solution of chlorate of lime in the proportion of one part of the salt to three of water, has proved very useful in the cure of ulcers, which have thereby been cicatrised in the course of eight or ten days. The proto-ioduret of mercury has had the same effect. M. Latbert asserts that in the military hospitals, the good effects of the chlorate of lime had been before verified. M. Vauquelin remarks that Dr. Chamsem had for some time employed the oxygenized muriatic acid diluted with water, as a drink in syphlitic diseases, but the irritation which it caused in the stomach obliged him to renounce it. The urine and the fœces were white and *entirely discolored.*—*Bull. Univ. Jan.* 1826.

32. *Theory of Flame.*—An interesting paper on the nature and properties of flame, was read by G. Libri, at the Society *des Georgophiles* (Florence,) on the 3d of December, 1826. The author was led to doubt the correctness of the theory or explanation given by Sir H. Davy, in order to account for the phenomenon of his safety lamp. The distinguished inventor ascribes the security which the lamp affords to the conducting power of the metallic gauze, by which it is supposed the temperature of the flame is so much lowered as to be insufficient to ignite the inflammable mixture on

the outside. Some facts known to the author were at variance with this hypothesis: and he found upon trial, that when single rods were made to approach a flame, the latter was always inflected, on all sides, from the rod, as if repelled by it, and that this effect was independent of the conducting power of the rod, whether good or bad. The amount of inflection or repulsion, was directly as the mass and inversely as the distance from the flame. It was not diminished by increasing the temperature of the rod, even to such a degree as to render it scarcely possible for it to abstract any of the caloric. In fact, when two flames are made to approach each other, there is a mutual repulsion, although their proximity increases the temperature of each instead of diminishing it.

"From these principles," says the author, "the theory of the safety lamp is easily deduced. A metallic wire, exerting, according to its diameter and its own nature a constant repulsion upon flame, it is evident that two parallel wires, so near each other as not to exceed the distance of twice the radius of the sphere of repulsion, will not permit a flame to insinuate itself between them, unless it be impelled by a force superior to the intensity of repulsion. If to these two wires others be added, a tissue is formed impenetrable to flame, especially when the conducting power of the wires adds its influence to that of the repulsion."

The author conceives, that, from the views above stated, the number of cross or horizontal wires in the Davy lamp, is unnecessarily large, and that by rejecting all of these excepting a number sufficient to secure the firmness of the tissue, the lamp would afford as great a security as at present, and at the same time diffuse a much greater light. This opinion he has verified by actual experiment.

Bibliotheque Universelle de Geneva, Mars, 1827.

33. *Power of Steam.*—The following laws of steam were announced by M. Morin, in an interesting course of Lectures at Geneva, attended by philosophers as well as artists.

First Law.—Whatever may be the temperature and pressure under which the steam is produced, the same quantity of heat must be employed to produce the same weight of steam; and as the quantity of heat developed is proportioned to the quantity of fuel, it is obvious that a given weight of steam, a kilograme, for example, will always cost the same price, whether it be produced at a low or a high pressure.

This important discovery is due to M. Clements, and is one of the finest results of his numerous investigations.

Second Law.—The volume of the same quantity of steam, is in inverse proportion to the pressure to which it is subjected. This law, discovered by Mariotte, is applicable to all gases. Steam acts, in many respects, as a permanent gas.

Third Law.—The dilatation of steam is $\frac{1}{267}$ of its volume at zero, for each degree of the centigrade thermometer. We are indebted for this law to the remarks of Gay Lussac and Dalton.

Fourth Law.—The latter gives the elastic force of steam, according to the degree of heat at which it is produced. The following table exhibits this law, which can be expressed only by numbers.

Pressure.	Centigrade.	Difference.
1 Atmos.	100°	—
2	122	22
3	135	13
4	145	10
5	153	8
6	160	7
7	166	6
&c.	&c.	&c.

Idem. Feb. 1827.

34. *Cyanuret of Iodine.*—To obtain this substance in a manner as curious as commodious, place upon a large square of glass, a very large bell or receiver, of the same material; and on another side, a mixture in the requisite proportions of cyanuret of mercury and iodine is to be heated in a porcelain capsule until the cyanuret is plainly beginning to form. The capsule is then to be expeditiously placed under the bell and the operation abandoned to itself; when the production of cyanuret of iodine will continue during 15 or 20 minutes, presenting the spectacle of a multitude of flakes of snow, extremely light and of a dazzling whiteness.

Annals de Chimie. Jan. 1827.

35. *Ammonia in the rust of Iron.*—It has been experimentally ascertained by Chevallier, that ammonia not only exists in the oxide of iron which is formed in situations exposed to animal effluvia, but that it may be obtained from oxide artificially prepared, under such precautions as will exclude the

presence of animal matter. Two ounces of clean iron filings were heated in a closed crucible, and when cold introduced into a flask with an ounce of water, the opening of the flask being dipped in mercury. Ammonia was evolved in decisive quantity, proving, as had been previously advanced by Austin, that ammonia is formed when pure iron is oxydised by contact with water and air. Chevallier found also that ammonia existed in a great variety of natural oxides, such as the micaceous iron ore of Elba, the red hematite of Spain, the jenite of Elba, &c. &c.—*Idem.*

36. *Improved Clock.*—Among the articles displayed at the "first national exhibition of the objects of art and industry," at *Neuchatel*, (Switzerland,) last year, we may mention particularly a clock made by Frederick Houriet, of Locle in which steel was used only in the main spring, and in the axes of the moveable parts: all the other parts are in brass, gold alloy, gold of 18 carats, and white gold. The number of pieces in pure gold, gold and silver, gold and platina, is sixty-two: all the pivots turn on javels and the functions of the free escapements, are effected also by means of pallets in precious stones. Some artists had observed to M. Houriet that the escapement and the spiral spring not being of steel, the inconvenience would result of a less degree of elasticity; but numerous trials and favourable results have removed the objection, and it appears evidently that gold hardened either by beating, (refoulement) or any other means known to the author, is more elastic than hardened and untempered steel. This clock has gone for six days, exposed to the contact of an artificial magnet, of the strength of 25 or 30 lbs. without experiencing any derangement. This new method of fabricating chronometers, may become of great importance to those bold navigators, who, like captain Parry, explore the Northern regions where the magnetic influence often exercises a very sensible action upon time keepers of the ordinary construction.—*Rev. Ency. Feb.* 1827.

37. *Neuchatel.*—A steam boat entered the ports of this town, under the roaring of cannon and the applauses of the population, assembled from all parts to enjoy the new spectacle. We are assured that the bed of the Thielle, a small river which will open the passage into lake Bienne, is to be cleared out, and from the latter lake, by means of a little labor,

the same steam boat can enter lake Morat, and thus establish a communication, rapid and convenient, between the cantons of Vaud, Berne, Neuchatel and Fribourg.—*Idem.*

38. Necrology.—*Pestalozzi* (Henry,) born at Zurich, the 12th of January, 1746, paid the debt of nature, after a short and painful illness, on the 17th of February last, at Neuhof, near Brugg, in the canton of Argovie.

Pestalozzi held the first rank among the philanthropists who aimed at the reformation of the people, through the instrumentality of education. Exalted virtues, an ardent zeal for the happiness of his fellow creatures, persevering labors in the career in which he had voluntarily engaged, useful works which have given him a title to the gratitude of mankind: we owe him the tribute of a gratitude which we delight to pay to the memory of the most illustrious benefactors of humanity; and we shall perform a duty to Pestalozzi, in a detailed notice of his life, his works, and his institutions of education.

For some years Pestalozzi had witnessed the progressive, decline, and eventually, the complete ruin of his institution, at Yuerdun, on which he had formerly founded his highest hopes. But, if he was not able to end his days in the midst of friends and disciples, whose care and affection would have sweetened his last moments, he was at least able to carry with him to the tomb the consoling certainty, that his examples and lessons will not have been expended in vain, for already many of his pupils, spread over various portions of Europe and America, have obtained, in the application of his method of education, a success which was refused to the venerable Pestalozzi, in his own country, during his long and beneficent career.—*Idem.*

39. *Progress of Science.*—An Atheneum has been established at Brussels, under the influence and authority of the king, in which are given ten courses of instruction, open gratuitously to all classes who seek for knowledge. The Professors have been selected among the most able men in the country, and the letters, it is said, informing them of their appointments, were conceived with a delicacy and nobility of sentiment which are at once an honor to the Monarch who dictated them, and to the philosophers to whom they were addressed. The professorships are, *General History*, (Le-

broussart,) *Domestic History*, (Dewez,) *Ancient Literature*, (Baron,) *National Literature*, (Lants,) *History of Philosophy*, (Vandeweyer,) *Physics and Astronomy*, (Quetelet,) *Chemistry*, (Drapiez,) *Botany*, (Kickx,) *Natural History*, (Vanderlinden,) *History of Architecture*, (Roget.)

The king has just created also a conservatory of arts and trades, and appointed M. Onder De Weyngaert Cantius, the director. A garden of plants was some time since established, of which M. Drapiez is one of the directors.—*Idem.*

EXTRACTED BY C. U. SHEPARD.

40. *Comparative Analysis of Olivine and Chrysolite, by M. Stromeyer.*—The specimens analysed were as follows :—

1. Olivine occurring in the basalt of Vogalberg, near Glèssen, very pure ; specific gravity, 3.3386.

2. Olivine occuring in the basalt of Kasalthof, in Bohemia, very pure ; specific gravity, 3.3445.

3. Chrysolite from the collection of M. Blumenback ; specific gravity, 3.3514.

4. Olivine occurring in the meteoric iron of Pallas: specific gravity, 3.3404.

5. Olivine occuring in the meteoric iron found at Olumba, in South America ; specific gravity, 3.3497.

6. A mineral having the aspect of Peridot, taken from a mass of iron, which is said to have been found at Grimmœ, and which has been preserved at Gotha, specific gravity, 3.2759.

	Vogelberg. (1)	Bohemia. (2)	Chrysolite. (3)	From the Iron of Pallas. (4)	From Olumba. (5)	Grimmœ. (6)
Silex, - -	40.09	40.45	39.73	38.48	38.35	61.88
Magnesia, -	50.49	50.67	50.73	48.42	49.68	25.82
Protox. Iron,	8.17	8.07	9.19	11.19	11.75	9.12
Protox. Mang.	.20	.18	.09	.34	.11	.31
Ox. Nickel,	.37	.33	.32	- -	- -	- -
Ox. Chrome,	- -	-	- -	- -	- -	.33
Alumine, -	.19	.19	.22	.18	- -	- -
	99.51	99.89	99.68	98.61	99.89	97.46

These analyses prove the *chrysolite* and *olivine* to be *identical.* The presence of oxide of nickel in these minerals is remarkable, and has never before been detected; it appears to exist in all the specimens which occur in volcanic rocks, for M. Stromeyer has found it in those of Vesuvius, of Auvergne, of Eifel, and of Itabichtswalde, while, to the contrary, it is wanting in the olivine of meteoric stones.

The mineral of Grimmœ differs totally from olivine and chrysolite in its composition.—*Annales des Mines, Tome* XII. 1826.

41. *Anhydrous Sulphate of Soda.*—Dr. Thomson has discovered the existence of an anhydrous sulphate of soda. It occurred in a manufactory of carbonate of soda at Glasgow, where the process consisted in mutually decomposing protosulphate of iron and common salt. The sulphate of soda thus produced is decomposed and converted into carbonate of soda in the usual manner. They were formerly in the habit of boiling their saturated leys, during which part of the process, large crystals were observed to form on the inside of the boilers; these crystals are the anhydrous salt, their form is that of an octohedron with a rhombic base, they are translucent, firm and solid in their texture, and of a glassy appearance.

Thus it is ascertained, that sulphuric acid and soda are capable of combining and crystallising without water, as well as sulphuric acid and potash. Three distinct species of sulphate of soda are now known to exist.

1. Anhydrous sulphate, crystallising in a boiling solution, in the form of an octohedron with a rhombic base.

2. Common sulphate of soda, containing ten atoms water, crystallising in a cold solution, and forming crystals which have the shape of doubly oblique four-sided prisms.

3. Sulphate of soda, crystallising in a supersaturated solution of sulphate of soda, made in a high temperature, and set aside for some days in a well corked phial, the crystals are opaque, white, four sided prisms, and contain eight atoms of water instead of ten.—*Annals of Philosophy. Dec.* 1826.

42. *Identity of Epistilbite and Heulandite.*—It is extremely probable that epistilbite is identical with heulandite. Dr. Rose who described epistilbite, was led to regard it as a distinct *species*, chiefly in consequence of its difference from the

heulandite in the form of its crystals; the physical characters and chemical compositions of both species being almost precisely the same. Mr. Levy has demonstrated that the forms and angles of epistilbite are derivable from the primitive form of heulandite, by simple and frequently occurring decrements. —*Phil. Mag. and Annals Philosophy*, *Dec.* 1827.

43. *Separation of Elaine from Oils.*—M. Pechet has proposed a new process for the above purpose, which is founded upon the property possessed by a strong solution of soda, of saponifying stearine in the cold, without acting upon elaine. Shake the alkaline solution with the oil, then warm it slightly to separate the elaine from the soap of stearine; it is then passed through a cloth, and the elaine is then separated by decantation from the alkaline solution. This process always succeeds, except with rancid oils or such as have been heated.—*Ann. de Chim.*

44. *Oxide of Carbon.*—M. Dumas has proposed the following method of preparing this gas: he mixes salt of sorrel with five or six times its weight of concentrated sulphuric acid; the mixture, when heated in a proper apparatus, yielded a considerable quantity of a gas composed of equal parts of carbonic acid gas and oxide of carbon; after absorbing the carbonic acid gas by potash, the oxide of carbon remains in a state of purity.

This result will be easily comprehended by supposing that the sulphuric acid seizes the potash and the water, and that the oxalic acid being incapable of existing under these circumstances, is resolved into carbonic acid and carbonic oxide.

This process may be successfully employed for examining the salt of sorrel of commerce. Bitartrate of potash, treated in the same manner gives oxide of carbon, carbonic acid and sulphurous acid, and the liquor becomes black by the deposition of carbon. The salt of sorrel, on the contrary, never yields sulphurous acid, and the sulphuric acid employed remains perfectly limpid and colorless.—*Ibid. Sept.* 1826.

45. *Enormous Fossil Vertebra.*—In the neighbourhood of Bridport, in Dorsetshire, a short time ago, a laborer digging for an ingredient used in mortar, found a vertebra of an enormous animal, larger than that of the whale, and supposed to belong to a land animal. This curiosity is in the possession

of a gentleman at Bridport, who generously rewarded the finder with ten guineas. Search has been made after the other parts of the same animal, but hitherto without success. The perforation for the spinal marrow is stated to be nearly equal in circumference to the body of a man.—*Ibid.*

46. *Phosphorus in Kelp.*—Repeated trials, by VAN MONS, have proved, that the roundish and longish veins found in the *varec-soda* or kelp, after the matter soluble in water has been removed, are principally composed of phosphorus. How did the phosphorus escape combustion?

Phil. Mag. and Annals Phil. Feb. 1827.

47. *Bismuth Cobalt Ore.*—This mineral has hitherto been found only at Schneeberg in Saxony: for a knowledge of it we are indebted to M. KERSTEN, of Gottingen.—*External Characters:* Colour intermediate between lead gray and steel gray; lustre metallic, and glistening or glimmering; texture radiated, partly stellular partly parallel. It scratches fluor spar, but this degree of hardness is occasioned by intermixed quartz. Streak dull, color not changed, but the powder soils. Specific gravity = 4.5 – 4.7.—*Chemical Characters:* Before the blowpipe on charcoal gives out white vapors of arsenious acid; deposits on it a yellow crust, during which the ore becomes of a brown color. When well roasted before the blowpipe, and then mixed with glass of borax and melted, it communicates to it a smalt blue color. If some small pieces of the ore are exposed to a low red heat in a glass tube, it affords a considerable quantity of arsenious acid. It is composed of

Arsenic, - - -	77.9602
Cobalt, - - -	9.8866
Iron, - - -	4.7695
Bismuth, - - -	3.8866
Copper, - - -	1.3030
Nickel, - - -	1.1063
Sulphur, - - -	1.0160
	99.9282

The characteristic ingredients of this ore are arsenic-cobalt, and arsenic-bismuth, a combination of these metals hitherto not met with in the mineral kingdom.

Jameson's Edin. Journ. Jan. 1827.

48. *Experiments on certain Oxalates.*—M. SERULLAS finds that when dry and pure oxalate of potash, either acidulous or neutral, is finely powdered with an equal weight of antimony and heated in a forge fire for eight or ten minutes in a covered crucible, there is always procured a button which is an alloy of potassium and antimony.

When well dried oxalate of lead mixed with very small portions of potassium, perfectly freed from naphtha, is put into the bottom of a glass tube, air being carefully excluded, by excess of the oxalate, a violent detonation suddenly takes place, before the heat is sufficiently great to effect the decomposition of the oxalate, when no potassium is present. The tube is spotted with metallic lead, the potassium is oxidized, and there is no carbon deposited. An examination of the gas resulting from this instantaneous decomposition, may elucidate the nature of the oxalates; but hitherto the apparatus employed has always been broken by the explosion. Oxalate of copper treated in the same way also occasions strong detonation, and metallic copper appears.

Journ. de Pharm. Nov. 1826.

49. *A method for facilitating the observation of distant stations in Geodoetical operations.*—Lieut. Thomas Drummond, of the royal engineers, having observed that quicklime when intensely heated, has the singular property of giving out a most vivid light, availed himself of a ball of that substance of the size of a pea, so placed in the focus of a parabolic mirror as to admit of being intensely ignited by the flames of several spirit lamps directed towards it by as many streams of oxygen gas issuing from separate blow-pipes; by which means a light of from seventy-five to ninety times the intensity of a well trimmed Argand lamp was obtained.—*Quarterly Journal, Jan.* 1827.

50. *Magnetic Influence in the Solar Rays.*—Mr. Christie has ascertained that a magnetic needle comes to rest more quickly when vibrated and exposed to the rays of the sun, than when vibrated in the shade, and this entirely independent of any mere effect of change of temperature. When the needle was *shaded*, he could easily make the *fiftieth* vibration; when it was *exposed*, he could not distinguish beyond the *fortieth.—Idem.*

51. *Compression of Water by High Degrees of force, and Liquefaction of Atmospheric Air.*—Mr. Perkins states that *a column of water* eight inches long, subjected to a pressure of 2000 atmospheres, suffers a compression equal to one-twelfth of its length and that, *atmospheric air*, under a pressure of 1200 atmospheres, was seen upon the surface of the quicksilver of "a beautiful transparent liquid, in quantity about one-two-thousandth part of the column of air."— *Idem.*

52. *Cultivation of Plants in Moss.*—Mr. Street has ascertained, that many plants thrive better if planted in common moss than in garden mould. The mosses used are various species of *Hypnum*, collected with the decaying stalks and leaves which are found amongst them. They are pressed closely into the pot, and the plants are put into them as if into mould.—*Idem.*

53. *Strength of Bone.*—Mr. Bevan finds that bone of horses, oxen, and sheep, has a cohesive strength per square inch, varying from 33,000 pounds to 42,500. One specimen of fresh mutton bone supported a load in proportion to 40,-000 lbs. per square inch, for a considerable length of time, without any visible injury to the bone.—*Idem.*

54. *Olbers on the Comet of short period.*—Dr. Olbers has calculated the approximation of the orbit of this comet, to that of our globe, near the ascending node of the former.

The heliocentric elongation of that point in the orbit of the comet, which most nearly approaches the terrestrial orbit, calculated from the ascending node is 1° 3′ 32″; the heliocentric longitude of this point in the orbit is 7231.2; the heliocentric longitude of the point in the terrestrial orbit nearest to that of the comet is 7229.26; the distance which separates these two points is 0.00.55604 of the mean radius of the terrestrial orbit, or 133$\frac{1}{3}$ radii of the earth.

The last time of the appearance of this comet therefore, (which was the 27th of February, 1826,) it passed by the earth's orbit, at only a little more than twice the greatest distance of the earth from the moon. The perturbations occasioned in the orbits of comets by the action of the planets, and especially by the powerful attraction of Jupiter, should make this distance vary at each revolution of the comet, and may tend as much to diminish as to increase the distance. It is therefore not impossible, that at some time the comet may pass at a very small distance from us, and even so near, that its atmosphere may be in contact with our globe.—*Idem.*

55. *Monochromatic Light.*—Upon the discovery of Dr. Brewster, that the flame of alcohol diluted with water, consists chiefly of homogeneous yellow rays, and his suggestion, that it would afford a monochromatic lamp useful for observations with the microscope, Mr. Talbot has constructed a lamp, which affords an abundance of yellow light for a long time. A cotton wick is soaked in a solution of salt, and when dried, placed in a sprit lamp. By employing ten of these wicks, which were arranged in a line in order to unite their effect for a microscope, a light was obtained little inferior to that of a wax candle. Its effect upon all surrounding objects was very remarkable, especially such as were red, which became different shades of brown and dull yellow. A scarlet poppy was changed to yellow, and the beautiful red flower of the lobelia fulgens, appeared entirely black.—*Idem.*

56. *Volcanos.*—Have the elevating effects of volcanic power been perceived on the Eastern side of the American continent?

Extract of a letter from G. POULETT SCROPE, Esq. *to the Editor, dated, London, March* 21, 1827.

In reply, I have to thank you particularly for your very liberal offers of contributing any facts, which may come to your knowledge, bearing upon that peculiar branch of the history of the globe, which I have applied myself to investigate. Such communications, I beg to say, will be most valuable to me, as materials for a second edition of the work* in question, which will probably at some time another be called for. May I take the liberty of hinting a few observations, connected with this subject, to which if the attention of some of your numerous geological friends and correspondents were directed, it must, I conceive, elicit some very important information. The volcanic force seems to have developed itself very rarely, if at all, under its most usual form, on the Eastern side of the great longitudinal axis of America, whether

* "Considerations on Volcanos, &c."

North or South. But this fact would lead to the supposition, that the *general* subterraneous force of expansion, must have exerted itself the more conspicuously in this direction, under its other mode, viz. the elevation *en masse* of solid strata. Is not this view corroborated by observations: are there no traces along the Eastern coast of North or South America, of former or continually progressive elevations? Does not the ocean seem to retreat more rapidly than can be explained by the accumulative action of the Gulf Stream on its shores? In Europe, on the rocky cliffs of Italy and Norway, we meet with the remains of recent lithophytes, and beds of fresh shells, on ledges, at heights of some hundred feet above the present level of the sea. Are there no traces of this nature to be met with in America?

Pray excuse my writing so hastily on a subject of such importance.

Remarks.—We shall be much gratified, if any of our correspondents will point out such facts as are alluded to by Mr. Scrope, for, the subject is one of deep interest. We take it for granted, that mineralized organic bodies, imbedded in solid limestone and other rocks, are not within the present inquiry, and therefore we do not mention the vast ranges of the Cattskill mountains, full of organized remains and bearing the relics of madrepores, encrinites, &c. and the vast formations of fragmented and brecciated rocks, (puddingstone and grauwackes,) to the elevation of three and four thousand feet; nor are we permitted to mention the elevated transition limestone of the Alleghanies, with its marine treasures. Our inquiries must therefore be limited, principally to the range of accurate history or of credible tradition. The voice of history respecting the American continents, speaks only for two or three centuries, and tradition, usually compensating by extent of range for the want of definiteness, has here little or nothing to suggest.

We may therefore ask directly:

Is it within the knowledge of any one that the sea has any where receded from our shores except as alluvion has entrenched upon it? Does any rock, any promontory, any seagirt fortress, on our coasts, or on those of the neighboring continent or islands, now stand higher out of the water than formerly? Have any rocks formerly sunken, or giving rise to breakers, raised their heads above the surf, and do they now receive the sun-shine as well as the impulse of the waves?

We will proceed one step farther: are there any decidedly volcanic appearances on the great Eastern water-shed of the North American continent? Is there an indubitable crater, a fragment of pumice, trachyte, obsidian, compact or cellular lava, or a current which may be supposed ever to have flowed, from an "ignivomous" mouth or fissure: any thing and every thing connected with this subject is interesting, provided it bear the stamp of sober and intelligent observation. Apocryphal stories, fables, and dreams of the imagination, would be as useless as undesirable.—Editor.

II. DOMESTIC.

1. *On the use of soapstone to diminish the friction of machinery, in a letter to the Editor, dated,*

Boston, Aug. 6, 1827.

Dear Sir: My time and attention having been very much occupied with the duties of my profession, since I was at New Haven, I had almost forgotten your request, that I should communicate for your inspection, such facts as I could learn, relative to the use of steatite or soapstone, as a means of reducing the friction of machinery. I have observed in the July number of the *Franklin Journal*, a short article copied from the *Edinburgh Journal*, in which reference is made to this use of soapstone. The fact is simply stated, that "it facilitates the action of screws, and from its unctuosity, may be employed with much advantage, for diminishing the friction of the parts of machines, which are made of metal."

I understand that soapstone has been used for this purpose in the extensive manufactories at Lowell, for about two years, and with great profit and success. Besides answering the purpose to which it is applied, very much better than any other substance that can be procured, it saves a great deal of trouble and expense. It is first thoroughly pulverized and then mixed with oil, tallow, lard, or tar, which ever may be the best adapted to the use for which it is designed. It is, of course, important to procure that which is free from *grit;* and it can be purified, in a good degree, by mixing the powder with oil, and diluting it after it has stood a few minutes. The heavier particles will form a sediment to be rejected. It is used on all kinds of machinery, where it is necessary to apply any unctuous substance to diminish friction; and it is said to be an excellent substitute for the usual compositions applied to carriage wheels.

Some idea of the value of soapstone, in this use of it, may be formed from the following fact, communicated by D. Moody, Esq. the superintendent of the Tar Works on the Mill Dam, near this city. Connected with the rolling machine of that establishment, there is a horizontal balance wheel, weighing *fourteen tons*, which runs on a step of five inches diameter, and makes from seventy-five to a hundred and twenty-five revolutions in a minute. About a hundred tons of iron are rolled in this machine in a month; yet the wheel has sometimes been used from three to five weeks, without inconvenience, before the soapstone has been renewed. The superintendent thinks, however, that it ought to be more frequently applied.

This use of soapstone was discovered at Lowell, by an accident, the circumstances of which it is not necessary now to repeat. It is sufficient to say, that it is regarded by those who have used it, as an invaluable discovery. I have been assured that it has never been known to fail of producing the desired result, when applied to machinery which had begun to be heated, even in those cases where nothing else could be found which would answer the purpose.

Very respectfully your friend, &c.

EBENE. BAILEY.

[A Fragment by Professor Eaton.]

2. *On Forest Trees, Orchard Trees, &c.*

TO PROFESSOR SILLIMAN.

If I do not misconceive the design of your Journal, one object is, to form a repository of insulated, as well as connected facts, which may be advantageously used by systematic authors. In accordance with this construction, I continue to send you items, which may be ranked among "the scientific mites which, in skilful hands, make up the grand phalanx of human knowledge."

Effects of Light.—Clouds and rain have obscured the hemisphere during the last six days. In that time the leaves of all the forests, which are seen from this place, have greatly expanded. But they were all of a pallid hue, until this afternoon. Within the period of about six hours, they have all changed their color to a beautiful green. As the only efficient change which has taken place is, that we have a serene sky and a bright sun, we may say with confidence, that this change of color is produced by the action of the sun's rays.

Seven years ago next month, I had a still more favorable opportunity to observe this phenomenon, in company with the Hon. J. Lansing late Chancellor of this State. While we were engaged in taking a geological survey of his manor of Blenheim, the leaves of the forest had expanded to almost the common size, in cloudy weather. I believe the sun had scarcely shone upon them in twenty days. Standing upon a hill, we observed that the dense forests on the opposite side of the Schoharie were almost white. The sun now began to shine in full brightness. The color of the forests absolutely changed so fast, that we could perceive its progress. By the middle of the afternoon the whole of these extensive forests, many miles in length, presented their usual green summer dress.

Direction of the branches of trees.—A tree shoots out its branches like all other trees of the same species, external circumstances being similar. But there is one remarkable fact in the direction of branches, which I have not seen noticed in any publication.

All trees with spreading branches, accommodate the direction of the lower branches to the surface of the earth over which they extend. This may be seen in orchards growing on the sides of hills, and in all open forests. But the crowded situation of the wild woods of our country, prevents a sufficient extension of branches to exhibit this character.

This fact presents a curious subject for the investigation of the phytologist. The question presented is this: What influence can the earth have upon the branches on the upper side of the tree, which causes them to form a different angle with the body of the tree from the angle formed by the branches on the lower side, so that all the branches hold a parallel direction to the earth's surface?

Hollow Trees.—The growth of trees is not influenced by any circumstance connected with their internal woody parts.

Mr. Knight's central vessel hypothesis, and the authority of numerous able physiologists, seem to be at variance with this position. I shall not enter upon a discussion of the subject, but merely introduce a few facts.

The sugar maple (*acer saccharinum*,) after being tapped and drained of its internal sap fifty years, and after the whole interior has become dead, grows as fast and presents an aspect as vigorous and blooming, as any sound tree of the same species and same age, which stands by its side. For the truth of this fact, I refer to all manufacturers of the maple sugar. I suggested this opinion more than twenty years ago, and frequently afterwards, when I was employed among the tenants of Messrs. Livingston, McEvers, Ludlow, Cutting, and others, between the spurs of Catskill mountain. Every manufacturer with whom I conversed, in this native residence of the sugar maple, confirmed my opinion.

The common apple tree (*pyrus malus*) grows thriftily and bears abundance of fruit, many years after its interior is so completely rotted away, as to leave but a very thin hollow cylinder in possession of the living principle.

We prefer solid trees in our forests and orchards; because they have more strength to withstand the force of winds, and because the unfavorable circumstance, which caused the interior to decay, may effect the total destruction of the tree. But as all depositions of matter, in any way affecting the growth of the tree, are made between the bark and wood, after the first year, in the form of a mucilage, called *cambium*, it seems that the internal woody part has no influence upon the external growth. Yours respectfully,

Amos Eaton.

Rensselaer School, Troy, April 30, 1827.

3. *Localities of Minerals in Vermont; communicated by* Augustus A. Hayes.

Brown compact feldspar,
Iron sand in limestone,
Calcareous spar in short hexahedral prisms,
Flesh red feldspar,
Earthy carbonate of copper,

Common serpentine, containing compact asbestus: this mineral is susceptible of a fine polish, and when polished, exhibits in a beautiful manner, the play of light, peculiar to fibrous minerals. The above are found in the township of Weathersfield, Vermont.

Actynolite in talc with brown spar and dolomite,
Acicular Actynolite,
Radiated mica of a dark brown color.
The above are found in the township of Reading, Vermont.
Granular foliated limestone,
Compact do.
Granular foliated dolomite,
Dolomite,
White tremolite,
Green do.
Adularia and green scaly talc, at Cavendish, Vermont.
Siliceous oxide of manganese, in all its varieties,
Octahedral iron, in small but very perfect and brilliant crystals,
Fibrous schorl, at Plainfield, N. H.
Phosphate of lime, and fibrous, and lamellar zoisite,
At Windsor, Vermont.

The above minerals are generally abundant at their several localities, and I have purposely omitted, mentioning many others, from which, as yet, but few specimens have been obtained.

4. *Phosphate of Manganese in Connecticut, New Locality of Tabular Spar, &c.* by Charles U. Shepard.—Specimens of an ore found in this state, at Washington, were brought here, some time since, for examination, by Mr. Horace Bushnell, a member of the late senior class. A larger and more recent supply, of the same substance, through the kindness of another student, who lives in that neighborhood, has enabled me to examine and ascertain its nature.

It is said to occur in a vein of considerable thickness, traversing quartz, which is embraced in granite. It is massive; and traversed with fissures in two directions, perpendicular to each other, to effect the separation of which, the strength of the hands is sufficient, even when exerted upon very considerable masses. So frangible is it rendered by these natural seams, that the slightest blow of the hammer reduces it at once to fragments, which, for the most part, affect a cubical form, although the third cleavage which produces this shape is not remarkably distinct. Externally, it is brownish black and dull; but, within, and especially in more compact specimens, it presents a clove brown color, and a glistening and resinous lustre. Its powder is a reddish brown. The cross fracture is imperfect flat conchoidal. It is opaque: scratches glass: and possesses a specific gravity of 3.5. A fragment brought within the exterior flame of the blow pipe, melted with intumescence into a globule, of a metallic lustre, and, which, when reduced to powder, was taken up by the magnet. It was soluble in nitric acid.

The following chemical trial confirmed the opinion I had formed concerning it from the above characters. Fifty grains in the state of an impalpable powder, were boiled with potash, to dryness, in a silver crucible. The alkaline mass, hence resulting, was lixiviated with water, and the insoluble part being separated and dried, had assumed a blackish color, and weighed more than the entire mineral employed. The watery lixivium was slightly supersaturated with nitric acid, and then boiled in order to expel any carbonic acid which might have combined with the alkali;—lime water being now added, a copious, white flocculent precipitate took place, which was phosphate of lime, and when dried and weighed, indicated a proportion of *phosphoric acid* in the mineral, equal to thirty per cent. The residue, which resisted the action of the alkali, was repeatedly digested in acetous acid; a considerable quantity of *red oxide of iron* was deposited. The fluid supposed to contain acetite of manganese, gave, as was expected, on the addition of potash, a copious precipitate of *oxide of manganese.*

Disseminated through the phosphate of manganese, and slightly adhering to it, occurs the *carbonate of manganese*, in a pulverulent state, of a delicate red color. Owing to the presence of this substance, the streak of the phosphate of manganese, may, at first be taken to be, of a deep red color, which we shall find not to be the fact, if we make trial of a more compact mass, or of a surface which is the result of a cross fracture, when we shall find it to be of a greyish brown. Intermingled with it also, are scales of mica, and occasionally a yellowish brown substance, having a laminated structure, and a considerable lustre, which appears to be garnet.

If I am not in an error, this is the only locality of phosphate of manganese in the United States, with the exception of Sterling, Ms. where, only a very few, minute specimens have been found, accompanying the spodumene; and as Limoges and Bavaria, its only other localities, afford it only in very small quantities, I doubt not, that this occurrence of it, especially, as it is abundant, will appear interesting to the mineralogist.

We are indebted to Mr. Bushnell for a beautiful specimen of *Mesotype*, which he discovered also at Washington. It is attached to a fragment of *gneissoid hornblende*, in which rock it appears to occur in veins. It consists of fibrous crystals about an inch in length, which are arranged in a stellular form, the centre of the aggregation being sufficiently compact to yield a splintery fracture. Its color is white, tinged occasionally with blue. It scratches calc. spar. Before the blowpipe, it immediately curls up, becomes opaque and vitrifies without intumescence: with borax, it, with difficulty, affords a transparent glass. Attached to the same specimen, and intermingled with the mesotype, I noticed several little masses of transparent, lamellar *Stilbite*. I am unable to give any information, at present, respecting the quantity in which this mineral exists, but the specimen before me seems to promise, that it will be found to be abundant.

I have much satisfaction in being able to indicate another occurrence of *tabular spar* in our country. Mr. Oliver P. Hubbard, a student here, has brought me a very beautiful specimen of this mineral, which he discovered at Boonville, Oneida county, N. Y. It precisely resembles the same mineral found at Willsborough, and with it, is associated, in place of the colophonite, which there accompanies it, a green granular *Pyroxene*, which, for transparency and richness of color, surpasses every thing of a similar nature hitherto known in this country. The contrast afforded by the delicate whiteness of the tabular spar and quartz, with which, it is mingled, and the fine green of the coccolite, renders it, if possible, more beautiful, than the Willsborough specimens. At any rate, the difference of appearance in the accompanying minerals of these places, will contribute, mutually, to enhance the interest of their specimens. Mr. Hubbard informs me, that it promises to be very abundant, although as yet he has not noticed it, *in place;*—the specimens he obtained, were from large boulders, which had been dug up, in effecting some improvements upon the public common in that place.—*Yale College*, *Aug*. 15, 1827.

5. *New Edition of Cleaveland's Mineralogy.*—We understand that Professor Cleaveland is preparing for the press, a new edition of his treatise on Mineralogy. We are informed that it will be considerably enlarged, and that it will give, as far as possible, a view of the state of the science, at the time of its publication.

Every new edition of this invaluable work will be received with interest by the public, as evincing the increase of knowledge in this important department, and as containing notices of all our most important discoveries and observations in mineralogy and geology.

6. *Cabinet of minerals for sale.*—We are requested to state that a gentleman in this country has a fine collection of minerals which he would dispose of on very reasonable terms. They consist of about four thousand specimens of every variety of Minerals that has as yet been discovered in the United States, as well as specimens of all the most rare foreign Minerals, systematically arranged and described. The whole would be sold together, or any number not fewer than five hundred, at fifty cents a specimen. Further particulars may be learned by reference to the Editor at New Haven.

7. *The late Dr. Robinson's Collection of Minerals.*—This collection of minerals, which some time since (see Vol. 10, p. 227, of this Journal,) contained "upwards of 4000 fair specimens labelled, wrapped in papers, and boxed in divisions ready for exchange, consisting mostly of New England minerals, including all those lately discovered," is now, in consequence of Dr. Robinson's death, offered for sale. It is understood to be a valuable collection, and reference for terms, and farther information may be had to Dan Robinson, Pawtucket, R. I.

8. *Exchange of Minerals.*—The subscriber having on hand, large duplicate collections of Pennsylvania minerals, is desirous to exchange them for those of other regions, either domestic or foreign.

George W. Carpenter, *Philadelphia.*

9. *Coat of Mail.**—The antiquarian would delight to hear, that there has been discovered, about fifteen miles north of this place, a *shirt*, without sleeves, made of wire, a little larger than that of the small steel purses;—in fact, a real coat, or shirt of mail, of the ages of Chivalry. It was found in the

* Communicated by Professor Hall, from James A. Paddock, of Craftsbury, Vt.

valley of Black River, I believe, within the limits of the town of Coventry. It was much rusted and decayed, but sufficient of it remains to show its shape.

10. *Kellyvale Serpentine.**—As connected with a favorite science, you would, perhaps, be glad to learn that there is a prospect of the serpentine of Kellyvale being worked the next season, on a considerably large scale. Mr. J. son of the honorable Mr. J. of Middlebury, who is engaged largely in the marble manufacture, informed me, that he should venture 1000 dollars in the business at Kellyvale. Men are now sawing slabs of serpentine, by hand, to take down to New-York in the spring, to try the market.

11. *Character of the People of Ohio.*—A warm panegyric on the character of the people of Ohio, is contained in an address by Caleb Atwater, Esq. which we have recently received in a pamphlet. Even if we abate somewhat for the ardor of the animated orator, descanting on a favorite and popular theme, we may still allow ourselves to believe, that enough is true to command our confidence in the people of a State, whose growth has been without example, and whose geographical position and physical advantages as well as moral and intellectual traits evidently destine them to stamp the character of the West, and to exert an influence there, not less prevailing than that which Virginia has commanded in the South, Pennsylvania in the middle States, and New York and Massachusetts in the North.

The Eastern States, and especially Connecticut, justly regard Ohio as their favorite daughter, and if they are too nearly interested to judge with impartiality of a population, and of institutions, which are, to so great an extent, their own, they cannot fail to sympathize feelingly, in the amazing prosperity of this noble State, which will soon contain a million of freemen, without one slave.

12. *Mule Silver.*—We are informed, by a correspondent, that the mules employed at the amalgamating mines, in Mexico, are opened after death and that from two to seven pounds of silver are often taken out of the stomach. He says that he is in possession of a specimen which is perfectly pure and white as it generally is.

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* Communicated by Professor Hall, from James A. Paddock, of Craftsbury, Vt.

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Art. I.—*Remarks on the Gold Mines of North Carolina; by* Charles E. Rothe, Miner and Mineralogist from Saxony.

At the solicitation of some of my scientific friends, as well in Germany as in this country, I will proceed to offer at this time, a few observations on the Gold Mines of North Carolina, in anticipation of a more regular account, of the geology of that region of country, which I contemplate publishing at some future day.

My first visit to these mines, was made more than two years ago, under the patronage of the "North Carolina Board of Agriculture &c." to which duty I was assigned by my scientific friend, Professor Olmsted, now of Yale College, but then Professor in the University of North Carolina and geologist of the State. During that excursion, my investigations were directed to ascertain the geological formations of the whole region, rather than to make a particular examination of the mines themselves. Having performed this duty, as well as circumstances would permit me, and made my report to Professor Olmsted, accompanied by a geological map of the country, I immediately returned to the Yadkin, with a view of examining more minutely the mines themselves. I accordingly spent several months at two of these mines, and during the summer, visited and examined all the others of any note, spending at each, sufficient time to ascertain, as far as possible, its extent and formation. Thus, I think my opportunities of forming a correct opinion of the Gold Mines of North Carolina have been superior to those of any other person, who has ever attempted to describe them. (*a.*)

The geographical situation of the mines of North Carolina is too generally known to require any further description at this time. I will therefore proceed to give my ideas,—*first,* on the geological structure of the gold region: and *then* on the causes which have heretofore rendered the mines of this region less productive than they will hereafter become, under a different state of things; concluding with a few general observations growing out of the nature of the subject.

(*A.*) Granite is the base of the formations of the gold region of North Carolina. It is constituted of course of crystals, and its surface is very irregular. On its more elevated situations, it has been much worn by the action of water in early times, and now lies exposed, at places on the surface of the earth in large masses, some of them round, as on the small mountain four miles south east of Salisbury. In the lower parts of the country, greenstone and greenstone slate are commonly found in beds in the granite. (*b.*)

The greenstone and greenstone slate, in respect of structure, differ in two particulars: 1st, In stratification, and 2d, In composition.

As to stratification. We occasionally find the greenstone distinctly stratified in almost regular parallel strata, which continue for some distance, when they are intercepted by a mass of the same substance, stratified in a different direction. (*c.*) At other places, the greenstone is found in irregular masses, showing no inclination to stratification.

As to composition. The composition of the greenstone and greenstone slate, bears a striking relation to the stratification. For example, I have noticed at those places where the greenstone is stratified, that the hornblende forms but a small constituent; while at those places where the greenstone is not stratified, the hornblende is the chief constituent; and sometimes so much so, as to lose its character of greenstone and to become basaltic hornblende. (*d.*)

In looking over the whole of this formation, we have abundant evidence to conclude that great derangements have taken place in it since its first construction. The cause and manner of these derangements, whether by earthquakes, by the contraction of the greenstone itself, or, from some other cause, we are left to conjecture. On some future occasion I may give my ideas on the subject.

This formation of greenstone is characterized by the existence of veins in it, containing gold and, in this particular, it differs from all others.

We here find the gold in two different situations.

I. As a part of the constituents of the veins, and

II. As an ingredient in the alluvial spots of ground in the ranges of this greenstone formation.

I. In veins. Before I give a particular description of the veins containing gold, it may be proper to give a short account of veins in general. (*e.*)

Veins, in general, are fissures in rocks, which were occasioned by the contraction of the original mass from its soft state, to a harder, or as some say, by earthquakes. These veins, at one time were open, and were subsequently filled by other materials than the rocks, or substances in which they are situated. Hence, from this it is clear, that different veins in the same formation of rocks may not only be of different ages, but may be made up of different materials; while veins of the same age in the same formation of rocks always very much resemble each other in their composition.

For this reason, in all mining countries, where the mineral is found in veins, whenever a new vein is discovered, it becomes an important point to ascertain whether the new vein is of the same formation as that of any vein before known. After ascertaining this, an estimate may be formed of the richness or poverty of the new vein from analogy with the others.

Experience has also taught, that we may form a pretty correct idea of the extent of a vein, in length and depth, from its thickness on the surface. (*f.*)

The last remark I shall make on this part of the subject is, that a vein cannot extend farther than the depth of the formation of rocks in which it is situated, but must terminate there. Hence it is highly necessary, in mining, to know the depth of the general formation at the place where you wish to operate.

These general remarks were necessary to a correct understanding of the veins in the greenstone formation embracing the gold region of North Carolina.

On a former occasion, I remarked, that the veins of the greenstone now in question are distinguishable into three formations, as well on account of their age as in other particulars. I will extend the view I then took of the subject.

The oldest formation of veins, pertains more particularly to the south west part of the gold region. The thickness of these veins is from two to four feet; their extension in length is known already to exceed a mile. This gives assurance that they sink to a considerable depth. Their general direction is east and west, dipping occasionally 40° to 50° North.—

The ores and minerals in these veins are: rhomboidal iron ore, prismatic iron ore, pyramidal copper pyrites and prismatic iron pyrites. In the last two, is a mechanical mixture of native gold. All these ores are in a mechanical mixture with each other. They show distinct signs of having been changed from their original form. Where the atmospheric air could have any influence on these pyrites, we find that one part of the sulphur has escaped; the consequence of which is, the metallic appearance of the pyrites is changed to that of brown reddish oxid of iron; and owing to this color we can see the fine particles of gold, and ascertain the richness of the deposit. But where the pyrites have not undergone this change, then the gold cannot be discovered, owing to the color being nearly the same. (*g.*)

The second formation of veins in which gold is found, is more extensive than the first, and occasionally contains richer deposits of gold; but I think they are less to be relied on for regular profits, than the veins of the first. The most of the veins in the eastern and north eastern section of the gold region belong to this formation.

I hazard the opinion, that the veins of this formation do not always extend to so great a depth as those of the one before mentioned; *first*, because, the greenstone superincumbent on the granite in this part of the region is comparatively not so deep, and *secondly*, the veins already discovered are seldom more than twelve to fifteen inches thick. The gold, and other ores particularly belonging to this formation are enclosed in rhomboidal quartz. It also appears, that the gold is sometimes deposited in other substances, which however are peculiar to certain places. (*h.*) The greenstone near the veins is most generally decomposed, and mixed with a great number of loose crystals of prismatic iron pyrites. Between the greenstone and the vein, or at the place of their junction, the gold is most generally found. Hence it is, that we often see specimens or pieces, composed partly of the vein, and partly of the greenstone apparently held together, and united by the gold which runs through both substances. All the large pieces of gold that have been found in this country, pertain to the veins of this formation. (*i.*)

The third formation of veins, is more widely dispersed than the two others, and may be found over the greater part of the region. Their thickness generally exceeds that of the veins of the first and second; and their direction, in length and depth, is seldom one like the other. The materials composing these veins are: rhomboidal quartz mixed with, pyramidal copper pyrites, prismatic blue malachite, diprismatic green malachite, prismatic iron pyrites, prismatic arsenical pyrites, prismatic tellurium glance, prismatoidal antimony glance, and lastly, here and there, fine metallic gold. It is very probable, that these veins, should they be pursued, if not productive in gold, may, at a greater depth, become valuable on account of the copper and other metals found in them.

After this brief description of the characteristical difference of these veins, it follows, that I should add something as to the relative purity or fineness of the gold in each.

The gold of the first formation may be stated at twenty-two and half carats fine; the alloy being iron and copper.

The gold of the second formation seems to vary in its fineness, at different places. The finest, as yet found in this formation of a beautiful gold yellow color, may be stated at twenty-two to twenty-three carats fine. (*j.*) While that found at other places does not exceed nineteen carats fine, containing a portion of iron and copper. (*k.*)

The gold of the third formation, as yet has but seldom been found in its original state, but mostly in the alluvial deposits.

II. We not only find gold as a constituent of the veins, but also in the alluvial deposits in the ranges of the greenstone formation. On a former occasion, I expressed an opinion, that this country must in ages past, have experienced an inundation. This overflowing was perhaps occasioned by an accumulation of waters on the other side of the blue ridge, which breaking over the ridge at some of the points now lowest, spread itself in rapid torrents over this region; and at places breaking up the veins containing gold, scattered them over the surface. An accumulation of water at one time must have taken place, above the range of little mountains which are cut by the Yadkin river, at the place called, the Narrows. For, at the Narrows, are evident marks on the rocks of the acclivous banks, showing that the water was once many feet above its present bed; and the highest hills near the river, as you go up the country are covered with alluvial deposits. (*l.*) The break may have taken place at the Narrows, that happening to be the softest place, and thus gradually letting the waters off.

By this means, or perhaps others, the gold now found in the alluvial deposits, *has been removed from the veins*, and scattered as far as the water had any influence over it.

It will follow of course, that at some places the gold will be further removed from its vein, or native bed, than at others, for the reason, that at some places the action of water was more powerful than at others.

The gold is most commonly found in the natural channels or beds of the water courses from the larger rivers and creeks to the smallest rivulets, and in the hollows formed by hills.—When found on hills or level ground, it is always in the vicinity of the veins, from which the weakness of the current could not remove it very far. (*m.*)

If we look at the gold deposited in the alluvial spots, we find a great resemblance to the gold as found in the veins excepting the changes which are produced on it by the action of water.

The gold found in alluvial spots in the ranges of the first formation, is most generally deposited in a soil partly composed of red oxid of iron, and magnetic iron sand. This bed or layer containing the metal, is nothing else than a mass of the vein, decomposed, and scattered over a greater or less surface. The proof of this is: first, that we discover the gold only in this peculiar layer, while we find it neither above nor below it, and secondly, the gold we here find is like the gold found in the veins.

Near the veins, we find the gold much in appearance as it is in the vein; while as it is removed, it becomes finer, and is washed smoother: and it becomes purer in the proportion it has been acted on; for the water and atmosphere purify it from those metals which are subject to oxidation. (*n.*)

The gold which is found in the alluvial deposits in the ranges of the second and third formation of veins, is always discovered in a decomposed greenstone, mixed with pebbles of quartz, the angles of which have been worn off by attrition. Here may be seen very distinctly the different layers, which at different times have been deposited. On the surface of the greenstone below all the other layers, is found a bed of a greenish colored substance, sometimes three or four inches thick, which is nothing but materials proceeding from the decomposition of the greenstone itself. (*o.*) The next bed is the one in which the gold is generally found. The thickness of this bed varies at different deposits and often at different places of the same deposit. In lower places, where the water stagnated or had less force, it is sometimes three or four feet thick, or even more. At other places, where the water had a more powerful current and where it still acts, it is thinner, often only two or three inches thick. (*p.*) Where this peculiar layer or deposit is not found, there is not much chance of obtaining gold; but this is seldom the case in the vicinity of veins.

The properties of the gold found in these layers or beds like those of the first formation, resemble those of the gold found in the veins from which it was washed. The gold found near the vein looks very much like that in the vein; but is broken into smaller pieces, and rounded off at its corners according to the distance it has been removed, and the quantity of attrition it has received. (*q.*)

The deposits of gold belonging to the second formation are often very rich and extensive. (*r.*)

(*B.*) Having made these remarks on the first division of the subject, it now remains for me to add some observations on the second head, *namely*, as to the causes that have heretofore retarded the development of these mines, and also on the prospect they present of becoming more valuable under a different state of things.

It will be recollected, that in the course of the preceding remarks, the mines were considered under two heads, *first*, the mines in veins, and *secondly*, the mines of the alluvial deposits. In my additional remarks, I will keep up the same distinction, first beginning with the alluvial deposits, for the reason that they have been more worked than the veins.

First. The most of the labor heretofore expended in pursuit of gold in this country, has been on the alluvial deposits, and from the best information I can obtain, some of these have been known and worked for a number of years; while, the existence of gold here in veins, is but a recent discovery, and no serious attempt has yet been made to pursue a vein to any considerable extent. (*s.*)

When it is considered that the alluvial spots alone, with few exceptions have been worked; and more particularly when we look *at the manner* in which they have been worked, we cannot but wonder at the great success that has attended these operations. As yet, but little science or skill has been applied to the gold mines of North Carolina. They have been worked in the rudest manner, and still continue to be worked in the same way. (*t.*)

The gold diggers generally may be arranged in two classes; one of which is composed of those who do little else than follow that business during the temperate part of the year; the other consists mostly of the less wealthy farmers of the neighboring country around; who seize on spare times from their regular pursuits to work at the mines: for instance, a week or two after their crops are put in, and before they require much attention; and after their harvest is got in and their corn laid by. The latter class is by far the most numerous.

No permanent fixtures are made at the mines, for the accommodation of the workers. Each man goes to the mine armed, with a few necessary tools, such as a mattock, a shovel, a bucket or water dipper and a rocker; also a stock of provisions sufficient to last during the time he allots to stay. They all encamp out of doors, each little company of three or four by themselves, sometimes under temporary coverings, made by a few boards, or formed by stretching a few blankets over poles set up for that purpose, but more often without any other protection from the dews of the night, than shelters made by the boughs of trees.

It is very common for two persons, and sometimes as many as five or six, to agree to work together and divide the proceeds equally. Where this is the case, they of course, mark off a larger lot of ground, for their operation, than when only one works by himself. Each man, or set of men having selected, and marked off their lot of ground, they commence digging down a few inches or even feet, until they reach the layer in which the precious metal is deposited,—throwing aside all the top earth. They then carefully take up the *grit*, as they call it, and remove it in buckets, hand-barrows or wheel-barrows, to the waterside where the ROCKER is placed.

A rocker is a simple machine, made of inch, or three quarter inch plank, in the shape of a cylinder equally divided lengthwise.

A common barrel thus bisected would, in form, make two of these rockers, though, they would be rather smaller than is common.

The rocker is placed on two poles, laid on the ground parallel with each other, and crosswise to the rocker, one near each end, so as to make it rock easily and regularly. The whole is near the water, so that the person using the rocker can reach the water with his dipper without moving more than a step or two. Thus arranged, the auriferous earth is thrown into the rocker, the same being nearly filled with water. The earth and water are then stirred up together with a common hoe, for a few minutes, or until the earth is well saturated and dissolved. Then the rocker is put in motion, like a cradle, until the water is charged with as much of the dissolved earth as it can suspend, when the rocker receives a tilt to one side, and the fluid is thrown out.* More water is then thrown in, and the same process repeated several times, or until the earthy part is all washed away. As this operation goes on, the larger stones are picked out with the hands, so that the washing being over, nothing remains but the gravel and sand in which the gold is mixed, which is still further reduced, by taking off the coarse gravel, to a gallon or two of fine sand. This is very nicely searched, and the fine gold picked up with the point of a knive,—the larger pieces having been previously taken up with the fingers. Sometimes the sand is transferred to a vessel smaller than the rocker, in order to collect all the fine gold. The whole of this process in washing down a rocker load of earth, is performed by an expert hand in thirty or forty minutes, unless where the rocker is very large, and the earth very tenacious, when a longer time is required. The principle on which the gold is here separated from the earth and gravel is its great specific gravity, which always carries it to the bottom, while lighter substances remain above it, and the dirt passes off with the waters. On no other principle than this can any machine be constructed to separate the gold from its other admixtures.

The gold thus obtained is carefully preserved, until the hour arrives for dividing what has been found. This generally takes place every evening at the mine, where the proprietor or his agent attends with his gold scales, and makes the division. When the proprietor has confidence in the honesty of a man, he allows him to keep the gold he finds, until the last of the week before the division is made. From this manner of doing business, it is very evident, that the workmen have every facility to cheat the proprietor, in not making returns of all they find; and the general belief is, that but few make true returns. Nor are there any means of detecting the unfaithful workman, there being so many places, where he can convert his gold into money.

About every mine of note, there are generally to be seen a number of lazy worthless fellows, who resort thither as the

* The gold from its great specific gravity remaining on the bottom.

place where they can most easily support themselves. They labor only enough to get bread and whiskey, perhaps a few hours in the day, or a few days in the week, and the remainder of their time they idle away in lounging from camp to camp, and in hanging about the whiskey carts, or huckster waggons, of which there are always several on the ground, with cider, spirits, provisions and other articles to sell.

It may be asked why the owners of these mines do not adopt a system, and carry on the business with more regularity. That they should do this is very clear, but there are several reasons why they do not :—

First. The proprietors of the mines, as yet discovered, generally are persons not well informed on the advantages of a different method. In the present way, without any expense on their part they have a handsome income ; and they are unwilling to forego these daily profits obtained in the old way, for the chance of getting even more gold on any new plan. Besides, they have but little confidence in any other method of operating. They think the rocker the best and perhaps the only way of getting the gold. In this opinion they are strengthened, by the failure of several injudicious and unskilful plans to wash the dirt, and separate the gold. The owners of the lands therefore on which the deposits are found, are the last persons that will expend money on any new plans, or for the erection of any sort of machinery.

Second. The owners of the richest mines, have heretofore, been unwilling to rent their lands to enterprising individuals on such terms as they could afford to take them. They are accustomed to receiving the half or third of what is found on their land, by means of the rocker, and it is difficult to make them understand, that they ought to take one tenth or one twelfth from those who would rent with the view of erecting labor-saving machinery. This prevents the best mines from passing into the hands of enterprising strangers, who might introduce system and method.

Third. The proprietor of a mine, much resorted to, does in fact make more for a time, by permitting the same to be worked in the old way, than he possibly could in the same time by any new method. For example: at the Beaver-dam mines, during a part of last summer, there were daily about one hundred hands at work, and the income to the proprietors was six or seven hundred pennyweights of gold per week. This was too large an income to be given up, for one depending on other and slower operations. The proprietors of these mines or deposits, resemble very much the boy with his goose that laid golden eggs. They are impatient to get the whole at once, and (as the boy served his goose,) they rip up their mines and greatly injure them. Instead of beginning at one end or side of the deposit, and carrying it on regularly, every digger sets in at any spot he pleases, and sinks down his pit. The consequence is, that in a short time, pits are sunk on every part of the ground, and the top earth thrown up in heaps all over the face of it. The old pits are now and then filled up, with the earth thrown out of the new ones, and in a short time it is difficult to tell what part of the ground has been worked and what not. Hence, it is not uncommon for persons to find more the second search than the first. New hands always miss the greater part of the gold, while experienced ones know how to save it. When the deposit is very rich, but little pains is taken to wash clean ; all are impatient to get fresh dirt, in the expectation of finding large pieces. Hence it is, that at some of the mines good wages have been made by washing dirt over, that had before been washed not once, but five, or six times. This is the case at Reed's and Barringer's mines.

Thus it may be seen, that there is nothing like a regular business carried on at any of the mines ; and, yet in this loose and unskilful manner, during every summer, large amounts of gold are extracted from these deposits. (*u.*)

It may be stated as a fact, that no mine is considered worth working, or is resorted to by the diggers, at which the hand cannot make his one pennyweight per day, clear of the proprietors share.

A pennyweight of gold is worth from eighty-seven to ninety cents in cash. First rate experienced hands, consider that they are doing bad busines, unless they can make ten to twelve pennyweights clear per week.

These facts, show that the mines of North Carolina are much richer than the alluvial mines of Brazil, where 2*s.* sterling is rather more than any hand can average, even with the aid of jetties. (*v.*) But the difference is, that in Brazil, labor and provisions are more than one hundred per cent cheaper than in North Carolina.

It is unfortunate for the gold mines of North Carolina, that they are situated in a part of the country where cotton is the leading staple of production. The cultivation of this article, has heretofore made labor high and provisions scarce. During the last summer, corn commanded one dollar per bushel at the mines, and even in the country as far up as Salisbury; this however we are told was a year of extraordinary scarcity, and that forty to fifty cents per bushel may be set down as the average price of corn in this region.

I entertain the opinion, that the great fall in the price of cotton, will soon begin to produce considerable changes in this country. It will drive part of the labor heretofore applied in that way, into new channels of industry; some to the mines, and some to the production of small grain and corn. This in time, will not fail to make, the gold mines of North Carolina assume a different character; when system, science and skill will render them extensively productive.

That these alluvial deposits of gold, can be worked with regular profits, I have no manner of doubt from my knowledge of the mines of other countries, and from the facts we know concerning these deposits themselves.

The great desideratum is labor-saving machinery. There are many extensive deposits, where, on a general average, each ton of earth promiscuously taken up, will yield sixty grains of gold.—Now if one ton yield sixty grains, it is easy to calculate what a machine would make, that could wash twenty or thirty tons per day.

From a small experiment I made, I doubt whether the machines used at some mines in Europe for washing gold and other metals will answer here. The gold there is mostly deposited in sand of a regular grain, while here, it is mixed with earth and stones of different sizes. New machinery must therefore be invented, and we ought not to doubt the practicability of doing it.

Secondly. The foregoing remarks apply altogether to the alluvial deposits. The working of the mines in veins, is yet to be spoken of. These, I think, will turn out, to be the most profitable. *First*, because the subject of veins is better understood and is susceptible of a more regular and certain business; *secondly*, in the alluvial deposits, the gold is spread over whole acres, while in veins it is more concentrated. There are however some causes that will retard the working of the veins. To work the alluvial spots in the common way, requires no capital. A few dollars worth of tools, is all that is necessary; each day pays its own expenses, and leaves a profit: while to work a vein, requires some capital more or less, as the case may be. Money has to be expended to some extent, even before the mining operation can commence; houses have to be built for the accommodation of the hands, the permanent fixtures made, tools and provisions provided, and all this before any gold is found.

In this section of the country, but few persons possess funds available to an enterprise of this kind, and as yet, the existence of regular metallic veins in this region, has not been known long enough to bring enterprising capitalists from a distance. In Europe, in Mexico, and South America, mining operations are generally carried on, either by the government, or by incorporated companies with ample funds and protecting privileges. And they must be carried on in this country in the same way, before much success will follow. (*w*.)

Another desideratum even more than capital, is wanting here—I mean science and skill. At Barringer's mine, a vast deal of labor has been expended, and after all the vein has been pursued only about thirty feet deep; the fact is, the most of the labor was misapplied, in sinking large pits at spots not near the vein, some places, two or three hundred yards off, and not even in the range or direction of the vein. Now, if a man acquainted with the subject had been present, nine tenths of this labor might have been saved, or directed to the proper point. These injudicious attempts have the effect not only to abate the ardor of persons concerned, but to deter others from making even proper efforts. (*x*.)

But this sort of bad management, and consequent failures, more or less, attend all new undertakings, and always retard success. Time and experience, however will in the end, overcome all obstacles, and we may with confidence conclude, that, as the gold mines of North Carolina become better understood, they will become more valuable and productive.

NOTES.

(*a*.) During the past two or three years, several notices of the gold mines of North Carolina have appeared in the public papers; but few of these are to be relied on. The reports of Professor Olmsted however are of a different character. They contain much correct and valuable information. Mr. Olmsted's reports may be found in "Silliman's Journal," and in the small volumes published by the North Carolina Board of Agriculture.

(*b*.) This granite, in its structure, resembles very much the granite called "Central Granite" of the mountains of Silesia and others parts of Europe.

(*c.*) This may be very distinctly seen at Barringer's gold mine, Montgomery county.

(*d.*) I followed this formation of secondary greenstone, passing into hornblende, in a north east direction, from Salisbury as far as the Virginia line: and it seems that the hornblende, west of Lynchburg in Virginia, belongs to the same formation.

(*e.*) My views on this part of the subject are according to the Wernerian theory.

(*f.*) Veins of two feet thickness in other mining countries have been followed two thousand feet deep, with but little variation.

(*g.*) My own experiments have satisfied me of the correctness of these remarks. Within the past two years, veins have been worked on, and at the depth of eight or ten feet no more gold is seen, but pyrites in great abundance are found. I have analysed some of these pyrites and find in them the same relative proportion of gold, as in the brown red oxid of iron.

(*h.*) As before stated, the first gold found, was in a matrix of quartz. The last finding was in a different substance. Professor Olmsted writes to Mr. Fisher of Salisbury that Professor Silliman has analysed some specimens sent him, and pronounces it to be "bitter spath—a magnesian carbonate of lime."

(*i.*) Barringer's and Reed's mines are examples in point—and it is very clear that the rich deposits of gold on the lands of Mr. Parker belong to the same, *i. e.* the second formation.

(*j.*) For example the gold found at Reed's.

(*k.*) For example the gold found at Barringer's.

(*l.*) For example the mountains on the Beaver-dam Creek.

(*m.*) Parker mine and several others furnish examples of this kind.

(*n.*) For example iron and copper.

(*o.*) Between this and the next bed, in the course of my experiments I have found pieces of wood and roots changed to bituminous mineral coal, lying about six feet below the surface; a proof that the inundation which broke up the veins and scattered the gold, probably took place at a time when vegetation already covered the earth.

(*p.*) Those places last mentioned are generally rich, because, the gold from its great specific gravity, remained, while the lighter parts were washed away.

(*q.*) This may be seen at the mines in Anson county and others.

(*r.*) For example the Beaver-dam mines, &c.

(*s.*) Almost every mine here, has been found by accident, which leaves a fair presumption, that there are as good or better ones yet to be discovered, as those already known.

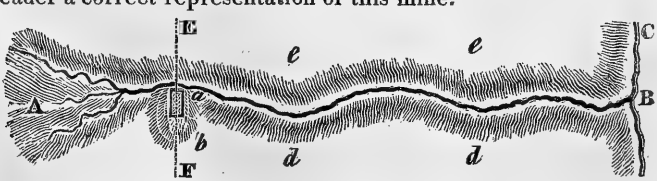
(*t.*) See the note on Barringer's Mine.

(*u.*) The last report from the United States mint, states, that about $20,000 of North Carolina gold was received at that institution during the year 1826. It is well known that but a small portion of the gold found at these mines goes to the mint. The silversmiths in every part of the country, north and south, purchase it up to be wrought into jewelry, and plate of all descriptions in their line of business. It is preferred by them on several accounts to gold coinage, and they consequently give a better price for it, than is given at the mint.

(*v.*) See Shaw's travels and others.

(*w.*) A year or two ago, several gentlemen of high respectability formed themselves into a company, with the view of working the gold mines on a scale of some extent and with skill and labor saving machinery. They applied to the Legislature of the State to incorporate them; but one branch of that body imposed such restrictions on the charter as to render it unacceptable to the applicants, and their friends rejected the bill. These gentlemen have purchased a considerable quantity of land in the gold district, mostly in Montgomery county; with what views I am not informed. I presume however, they calculate on finding their profits in the rise which will inevitably, at no distant period take place in the price of lands there. It is probable they also expect that mines may from time to time be found on their lands, as they lie in the gold region.

(*x.*) The gold is found at Barringer's mine, as well in the alluvial state as in the vein. The following diagram, will give the reader a correct representation of this mine.



AB is a small branch, running along a hollow, formed by hills rising pretty abruptly on each side, *e*, *e*, *d*, *d*.

BC is long Creek into which the branch runs.

Along the bed and sides of this branch from B to the line E and F and in the creek from B to C, gold for several years had been found by washing in the usual way. Mr. Barringer employed the time he could spare from his farm in searching for gold in this way; and as it was a regular business with him, he began at B and worked up the stream towards A finding gold as he advanced until he passed the line EF when he ceased finding. The sudden failure of the gold appeared to him as something strange, and uncommon, and he determined to search into the cause. The idea struck him that possibly "the gold might have come out of the hill" as he expressed it. Returning to the spot where he ceased finding gold, *to wit*, to the line E and F and seeing a few flint rocks on the side F he commenced digging at that place. He had not dug more than two or three feet into the side of the hill, and as many deep until he struck a *nest* of gold richly intermixed with quartz and running through it in all directions. About twelve or fifteen hundred pennyweights of gold were taken out here in the course of the day. The gold was now ascertained to be in a regular vein, situated in the greenstone slate. The matrix of the gold was quartz, and in fact, the vein at this place was constituted mostly of quartz. In pursuing the vein a few feet deeper and further into the hill a second nest of gold was found equally rich, and still following on further and deeper, a third a fourth and fifth deposit a few feet a part, were found, making in the whole 1600 to 2000 dollars worth of the precious metal. As they descended, the gold was found in a different matrix from quartz, but whether belonging to the same vein or not, I have no data to determine. By this time the pit was sunk ten or twelve feet below the level of the branch, and at about twenty-five feet below the surface of the earth, the ascent of the ground from *a* to *b* being twelve or fifteen feet in thirty yards. The water now began to flow in, through the fissures of the rock, in such quantities as considerably to retard the work. The pit from *a* to *b* in its whole length was laid open from the surface down, and the earth and pieces of rocks carelessly heaped up on the sides, so that every rain, that fell carried its torrents into the pit,—no part of it being covered, and the rain too falling on the piles of earth and stones on the sides of the hole, large parcels very often slid into the pit, and of course gave new employment until removed. Under these disadvantages, and for the want of skill, the work of following the vein went on slowly. The winter rains setting in, made it still worse, and it was found necessary to abandon the whole work until the following summer. During the following summer, the work was resumed under an ephemeral association of a few individuals, who expected without capital to open the vein, and make their fortunes. But their limited means were exhausted in removing the rubbish and they had scarcely commenced operating, when their money and enterprise gave out at the same time, and they too stopped with a view of resuming their labor, but before they could do so, their lease expired.

I have been thus particular in describing Barringer's gold mine, because it is the first place in this region, at which the metal was found in a vein, and this discovery has at once thrown so much light on the subject as fully to develope the character and nature of the gold mines of North Carolina.

The line E and F represents a section of the vein, running nearly north and south. Torrents of water passing down the hollow, where the branch now runs, gradually wore away the earth, and broke up part of the vein, scattering it with its gold in the direction of B, and by the force of the current, carrying some of the gold down long creek towards C.

The gold found in the branch and the creek is at once recognized to be like that taken out of the vein at EF with the exception that it plainly shows the effect of having been worn by attrition.

No attempt has yet been made, to pursue the vein in the direction of E, though reason and analogy would teach us, that it may be as rich in that direction as in the contrary one. In fact no serious attempt has been made, to pursue any part of the vein; but this cannot long continue to be the case.

Art. II.—*On Mystery; by* Mark Hopkins, A. M.*

We may well suppose that the first feeling of Adam was a feeling of mystery. With the conviction, elementary in every mind, that there can be no effect without a cause; with the consciousness of his own inexplicable being; creation in its original brightness, bursting at once upon his view, and indicating itself through all his senses; he must have felt that mystery enveloped himself and all that he beheld. Accordingly,

> "As new waked from soundest sleep," said he,
> "Soft on the flowery bank I found me laid,
> Straight toward heaven my wandering eyes I turned,
> And gazed awhile the ample sky.
> Thou Sun, said I, fair light,
> And thou enlightened earth, so fresh and gay,
> And ye that live and move, fair creatures, tell,
> Tell if ye saw, how came I thus, how here."

That was a sublime moment—such an one as none of his descendants, under the deadening influence of the familiarity

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* Late a Tutor of Williams College.—Ed.

attendant on gradual perception, can ever enjoy. But his descendants have shared largely of the emotion; and who of us, as we too, have gazed the bright earth, and the ample sky, has not found himself insensibly falling into this original feeling, and one bewildering sense of the mystery of being and its phenomena engross his soul? But it is not only in these moments of higher and intenser feeling that it arises; life is full of it, and to a thoughtful mind, it is constantly springing up.

The philosophy of our emotions, consists in a knowledge of the occasions on which they arise; and as the exertion of great power is essential to the sublime, and slight incongruities to the ridiculous, so there must be somewhat in mysterious facts which render them mysterious. To ascertain what this is, and how far mystery can be solved, will be the objects of the present inquiry. Some remarks will also be made on the nature, extent, and practical bearing of the emotion.

I shall first speak of the mystery of particular facts, and of the solution which it is ordinarily supposed to admit; and then of the mystery of general laws. To discover the true foundation of this emotion, it is necessary to distinguish it from ignorance, with which it is often confounded. Mystery does indeed imply ignorance, and in the removal of both, the principle of curiosity is involved; but there may be ignorance without mystery. In an ignorance of any disconnected fact, or class of facts, as of topography, or chronology, there is, and can be no mystery. One may be ignorant of the year in which the battle of Actium was fought, and unable to ascertain it; but it is simple ignorance, there is no mystery about it; it may have happened, and no reason can be given why it should not have happened, in one year as well as in another. One may be ignorant whether Actium was in Europe or in Asia, but he has only to consult authorities, and his curiosity is satisfied, but no mystery is solved.

Further, though there be a connexion between facts, yet, if the rule by which their cause operates be entirely unknown, there can be no mystery. This is the case in the blowing of winds; and for the most part in human conduct, which last however, is so much governed by known principles, that it may become mysterious when conduct runs greatly counter to its ordinary course.

I am now prepared to observe, 1st, that those events *are* mysterious which apparently conflict with a general law previously known, or with a theory, which, as a ground of reference, is equivalent to a general law, or in other words, that mystery lies in the apparent contradiction between particular facts and general principles, where we conceive that there ought to be agreement; and 2d, that the only solution of which mystery admits, is a discovery of the manner in which the mysterious fact conforms to the general law. These positions I proceed to illustrate.

For those facts which can be referred to a general law, a reason can be given, and they are not generally deemed mysterious. If we inquire the cause of sound, we are referred to vibrations, and our inquiry is satisfied. It is a general law that vibrations produce sound. If we inquire why heavy bodies descend, we are, in the same manner, satisfied by a reference to gravitation. But let a fact conflict with the general law—let vibration come to an organ seemingly perfect, and no sound be produced—let a stone thrown into the air, remain suspended, and there is a mystery at once; there are curiosity and wonder blended together, and these form mystery, as expectation and desire form hope.

But to mention instances which actually occur. We are informed that the north star has no actual motion; we observe that it has no apparent motion; but since the earth moves, this fact is mysterious, till we learn the effect of distance in destroying parallax; then the mystery vanishes. On first learning the tendency of all matter to all matter, the ascent of smoke, and light bodies is an apparent exception, and a mystery to him who is unacquainted with the weight of the atmosphere; but when this fact is known, the mystery is solved, and the general law confirmed. Again: a pendulum of a given length vibrates seconds at the equator. It is found that a longer one is required at the poles. This is a mystery till it is ascertained that the earth is a spheroid, flattened at the poles, and then the mystery is solved. Such apparent exceptions to her general laws are the mysteries which nature presents, and which it is the business and delight of philosophers thus to solve, by showing their conformity to the general law.

In the origin and growth of a new science the general principle is the same, though somewhat modified. Suppose we have hitherto known of motion only as communicated by impulse and gravitation—by accident a magnet is applied to a piece of iron, and the iron approaches it. It is mysterious. Experiments are performed, and a bar of iron magnetized and balanced on a pivot, is found to point invariably north and south. This is another mystery. These facts are published, and philosophers over the world are in commotion. Experiments, dissertations, and treatises succeed, till the facts are all ascertained, a science formed, and a name given to it—and now if we are asked why the iron approaches the magnet, we say that it is by the influence of magnetism, and the mystery is solved. This sketch applies with perfect truth to the formation and growth of every physical science. If the facts can be reduced to no order, as was long the case in astronomy, no science is formed, and philosophers continue to observe, form theories, and make experiments till they effect it. If they succeed in some measure, as in electricity, but many facts still remain anomalous, the science is imperfect. If no anomalous fact remain, as in astronomy, the science is perfect. What the facts are, and the manner in which they conform to the general law, is all philosophy can know, all it can teach. Thus physical science is but a history of facts which take place in a certain determinate order, and differs from other history in nothing but the assurance which it brings with it, that in this, past and future experience will invariably accord.

In theology and morals, our theory, or the obvious dictates of the understanding, are in place of the general law; and facts that conflict with these, are mysterious.

Our whole nature leads us to the conclusion that the object of God in his creation and government, must be happiness. The extent to which evil and misery prevail, is a mystery. When we shall see the bearing of all this on the general and greatest good, then will this mystery be "finished." Our practical feelings tell us that we are free and accountable agents; but the possibility of this is to some minds a mystery. Upon them the conviction of the contrary comes with all the force of a demonstration,—drives out the belief if not the sense of guilt,—beats down the natural sense of things,—destroys the force of motives,—and in the fierce struggle of feeling and conviction, prostrates the best powers of the man. This mystery would be solved, by a knowledge of the manner in which motives act upon us. Of this kind are most of the mysteries mentioned in the Scriptures. "That you may understand" says St. Paul "my knowledge in the mystery of Christ, that the Gentiles should be fellow heirs, and partakers of the promise." To a Jew, whose conviction it had been from childhood, that the Gentiles were to be excluded, their reception was a mystery.

It is obvious from the above, that facts may, in our present sense of it, be mysterious to one person and not to another, may be so to ourselves at one stage of our inquiries, and not at another. Anomalous facts are distressing to a well constituted and philosophic mind, and few pleasures are greater than the unexpected reconcilement of a perplexing phenomenon with our theory, or what is the same thing if our theory be true, with the general rule. But when, by an induction of particulars, we infer the law itself, as did Newton that of gravitation, it is a discovery in the highest sense, and no earthly pleasure is more sublime. It is no wonder that his frame trembled as the mystery that had brooded over a chaos of facts was solved at once, and that he relinquished to another the details of the calculation.

But could all facts be thus reduced, and every science, in the sense above mentioned, become perfect, would mystery cease, and our knowledge become perfect? To all practical purposes it would. Nature is uniform, and we have the most entire conviction that as she is to day, she will continue till her dissolution. If then we knew perfectly, the laws by which her sequences are regulated, facts would become emphatically of the nature of language, announcing what was to come. It would enable us to exercise far more perfectly the high prerogative of man, as the interpreter of nature, and to consult more surely for our happiness as prophets of future events. It would confer upon us the "nil admirari" of the wise man, and nothing could surprise us. Humble as it may appear, it is the only true and practical knowledge, and if we think of attaining farther, we are ignorant of our powers and pursue a phantom.

But the human mind does not rest at this point. Men of every age have felt, as we do, that there was a higher and deeper mystery beyond, and asked after the mysterious power which carried the general law into effect. To the mystery of general laws therefore, we now proceed. I have before alluded to the fundamental principle of conception by which it is absurd to suppose an effect without a cause, and by which Adam was susceptible of the emotion of mystery; and it is by the operation of this that we feel the mystery of general laws. A permanent and universal tendency is obvious, but the cause is concealed. To solve the mystery of these, it is necessary to find some cause still more general, to which they may all be referred. With regard to such a cause various hypotheses have been formed, all of which however are entirely unsatisfactory except that which resolves all effects into the immediate agency of one mighty and intelligent Being. This would doubtless have been generally adopted, were it not, that though the cause at work, in general operates like a wise and intelligent agent, yet if it be artificially thwarted, it will still go on, and form ludicrous, abortive, and monstrous combinations. If then we suppose it to operate otherwise than by a surd necessity, we must conclude that such operations are called for by the general scheme of Providence, to announce, (which is of great importance,) the stability, in all cases, of the general rule. If this hypothesis be adopted, we may consider every general law as a single fact, and all general laws as a class of facts, referable to the simple volition of the Deity as their cause. In such a case, the volition takes the place of the general law, as being that to which every thing is to be referred; and the mystery remains in the fact that volition can communicate motion at all, and in the existence and infinite energy of the will exerted. This sublime view of the universe and its Author, we may perhaps hereafter fully take in and enjoy.

In all this however, it will be perceived that we have merely traced causes more limited to those more general, but have not proceeded one step in removing the obscurity which hangs over existence, and the nature of causation. It will also be perceived, since a general law is only an abstract name for a uniform mode of operation, which name can have no efficiency, that the power which operates according to the law, must be immediately exerted in producing every individual effect; and that if the law be mysterious, the particular facts, from an observation of which the law was inferred, must, truly and philosophically speaking, be equally so. It will then follow that every event is in fact equally mysterious,—yes, every event, and it is familiarity alone that deadens the sense of it.

From this universal mystery, it results, that the creation of the world, the resurrection of the dead, the mode of God's being, and all those facts which from their nature, admit to us, of no experience, or analogy, but still involve no contradiction or absurdity, are to be believed on good testimony however far they may be removed from the course of our experience, or strange to our manner of conception. Since all events are equally mysterious, we ought, as philosophers, on equal testimony, to believe one thing as readily as another, and upon sufficient testimony, to believe any thing that is not absurd. Pure spiritual existence is much more simple in the conception, than the complex manner in which we exist, and we may easily suppose that when the rumour of man's creation reached the other world, some sceptical spirit may have entered into a disquisition on the possibility of such a mode of being. It must have appeared, if not impossible and absurd, at least highly improbable, and testimony alone could have been appealed to, by his fellows, who knew as little of the *nature of the case* as himself.

The feeling excited by mystery, is, as I have said, a union of wonder and curiosity, and when the mystery is deep, becomes a sublime, and at the same time a humbling emotion. Having, as we have seen, its foundation in a principle of order, and always implying the conviction of this, it necessarily involves the higher powers of intellect, and affords, what philosophers have sometimes been at a loss to find, a ground of distinction between man and the brutes. We may therefore esteem it, notwithstanding it implies ignorance, an evidence of our dignity. It is obvious also, that it must most frequently arise in contemplative and philosophic minds.

Of its uses, we may say, that as it is, in great minds, a deep and absorbing feeling, it gives a powerful stimulus to physical inquiry. That it enters largely into the devotions of the pious, and affords an occasion for the exercise of the highest possible faith, and the most sublime confidence in the divine administration; and that without it, the present state, as a scene of discipline, would be essentially changed. Even in the way of argument, important conclusions may sometimes be deduced from it, as that for a future state of rewards and punishments from the mystery of the present mode of administration.

Of the essence of mind or matter we have not, and perhaps no finite being can have the power of forming an elementary conception. But aside from this, we see from what has been said, that the intelligence and experience, which we may hope for hereafter, may enable us to solve all those difficulties, which we now term the mysteries of Providence, to reduce every physical fact to its general law, (consequently to behold the universe without an anomaly,) and to refer all general laws immediately to the volition of the Almighty. That will indeed be a noble elevation of being to attain unto, when, as clearly and as directly as the rays of light emanate from the sun, every being and event shall seem to flow from the energies of Omnipotence, and the depths of ineffable love. But though all mystery may thus far be removed, clouds and darkness must still rest upon the existence, creative energy, and attributes of the Great Cause uncaused, and the darkness of "excessive bright," forever encompass his throne.

Art. III.—*Some data for the Natural History of Orange County, N. Y.; furnished by* Jer. Van Rensselaer, M. D.

New York, May, 1827.

Dear Sir,

I send you a few observations made in Orange county in this state, and taken from the MS. Medley Book of Jesse Booth, an old gentleman who has long been an accurate observer of nature. Some of these notices may prove interesting to your readers, and thus will be valuable to the future historian or naturalist, if recorded in your Journal. They will serve as data in writing the natural history of Orange county.

Yours respectfully,

Jer. Van Rensselaer.

Prof. Silliman.

On the habits of the locust cicada septemdecem.

When I was a small boy, observes Mr. Booth, I saw the locusts in their winged state—and when I saw them the second time, which happened in 1792, my curiosity was excited to know in what year they were up when I was a boy. From many facts that came to my knowledge, and from its being well remembered by most of my neighbors, I ascertained that the first time I saw them was in the year - 1775,

The second time I saw them up in the year 1792,
The third time " " " 1809,
The fourth time " " " 1826.

The first time that I saw the locusts in their winged state, they were according to my recollection, much more numerous than when they returned in 1792, and their numbers were very perceptibly lessened the third time, and still more diminished the fourth and last time.

When returning from New York in 1817, Col. W. Faulkner informed me that he had seen four locust years, or periods of their being in the winged state; that at the first period they were in vast numbers, and that at every subsequent period, or time they were up, their number visibly decreased.

There are several probable causes why they should decrease in this country at the successive periods of their visitation.

First.—The soil best adapted for breeding them was formerly burned over, almost every year by the Indians, so that the female locusts had small suitable brushwood of one or two years growth to deposit their eggs in.

Secondly.—When land has been divested or cleared of brush and timber for more than seventeen years, none of the young insects or crysales live or breed in it—as no eggs are deposited in it—so that the clearing of the lands of timber lessens their means of depositing their eggs.

Thirdly.—There is every locust year, great destruction made of them by our domestic as well as wild fowls.

It was on the 5th June, 1809, that I saw the first locusts for that period, that had left their holes in the earth to become aerial inhabitants.

It is interesting to observe the habits of these insects, when they leave the earth in which they have been so long imbedded.

Such of them as came out of their holes near sunset, and through the night, and so on till sun an hour or two high next morning, would climb up trees, shrubs, rails, or whatever might be convenient to them—so that they got to an elevation from the earth, some of them not more than five or six inches, and at all heights from that to twelve feet, as the bodies they happened to climb would admit of. Here they remained firmly attached, until the day became warm and dry, when a crack or fissure would form on their backs, and a locust would come out of its earth-coat, nearly one third larger, and as white as milk. In an hour or two after (if the day was dry and warm) they were perfectly released from their old coats or suits, they became black, and then took wing and flew about.

Such of them as happened to leave their holes in the early part of a dry and warm day, would most commonly get some distance from the ground, and then shed their coats, turn black, and fly about in two or three hours.

There was a difference of several days in the leaving of their holes, between such as bred in warm soils and situations, and such as were in soils and situations that were damp and cold.

On the 11th June, (1809,) near twelve o'clock, was the first that I heard the locusts sing that year—so that they must have been out of their earth-suit six days.

On the 1st day of June, 1792, the locusts were at their greatest height of singing for that year, but in 1809 it must have been nearly the middle of June, which was owing to the coldness and backwardness of the season. The two first locust years that I saw them, they would collect on trees, bushes, &c. and their songs might be said to be heard every where: but in the year 1809 they seemed to collect mostly in warm situations. They flew from my orchard between ninety and one hundred rods, to my timber land, by thousands; and at that distance I have often amused myself by listening to their united songs. It is only the male that sings, and he makes the sound or song with a small white spot under each wing. It appears to be a note or love call to the females, for they commonly flew in greater numbers to the spot where the loudest songs were heard.

The female, after union with the male, deposits her eggs, by means of a probe or sort of sting, in the tender twigs and branches of bushes and trees, with a great deal of application and labor.

It was on the 12th of July, 1809, that I heard the last singing of the locust, so that the males live probably only about forty days after they begin to sing; and in about fifty days or less the whole of them die.

After the females had deposited their eggs in the summer of 1809, my curiosity was so excited that I constantly examined the eggs, deposited by thousands in the small limbs of bushes and trees; and I found that they were all hatched (in other words, were all empty) in the latter part of August.

In digging or ploughing land that has young locusts in it, they are found two or three years before the locust year. They are then small, and each one occupies its own appropriate hole or cell, which is a little wider than the body of the insect, and approaches within two or three inches of the surface of the earth. In the succeeding years, each one, as it increases in size, keeps widening its hole, and working it nearer to the surface, so that each locust has its opening worked to the surface two or three weeks before leaving it. In some suitable places and soils their holes are very near each other, and the surface is perforated like a riddle.

I have not transcribed my observations for this year, (1826,) It is an erroneous opinion that locusts appear only at stated periods. That they have appeared in very large numbers, at regular intervals of seventeen years, during the last eighty five years—making five visits—is beyond all dispute: but, a few locusts are heard to sing almost every year. On the 14th of June, 1812, I heard one sing—on the 11th of June, 1913, I heard several.

It should have been mentioned in a former part of this paper, that in clay land there appear to be more holes than in any other soil—in loam not so many—in stony ground fewer —and in morasses none. They breed mostly in woodlands, none in old clear fields, except under hedges, single trees or orchards. In case a piece of wood or brush land is cleared the summer after a locust year, they will come out of it in as great numbers as if it were covered with wood and timber, and the usual period of visitation had arrived.

*Date of the annual song of the Kitty Didet.**

It is known that it is the male Kitty Didet that sings, (as it is improperly called,) its love song to attract the females. The noise is made by flat transparent plates, one on each wing, near to the back, which are grated on each other with some force and great rapidity. When they first sing, they are only heard in the evenings and nights, but after the severe white frosts in October, and the weather has become cold, they sing only in the warm sunshiny days. They usually appear in the month of August, as will be seen by a record of the last sixteen years.

1809, they were first heard on the evening of Aug. 22,
1810, " " " " " 8,
1811, " " " " " 8,

* This insect was considered by Linnæus and his followers as a Gryllus, but since the division of that genus by Fabricius and others, it has been assigned to the new genus Acheta, of which there are about twenty species, but the specific name of our Kitty Didet, has not, I believe, been determined.

1812, they	were	first	heard	on the	evening of	Aug. 21,
1813,	"	"	"	"	"	6,
1814,	"	"	"	"	"	1,
1815,	"	"	"	"	"	13,
1816,	"	"	"	"	"	25,
1817,	"	"	"	"	"	16,
1818,	"	"	"	"	"	2,
1819,	"	"	"	"	"	3,
1820,	"	"	"	"	"	2,
1821,	"	"	"	"	"	6,
1822,	"	"	"	"	"	1,
1823,	"	"	"	"	"	7,
1824,	"	"	"	"	"	16,

Remarks.—The summer of 1809, was cold and moist; an early frost happened on the 3d Sept. so that but few fields of indian corn were ripened when the frost first came on; and those that did were planted in warm situations about the 1st of May.

1816.—A cold dry summer, with light dews and poor crops of indian corn.

1818.—A warm summer.—1819.—Do. do.

1820.—A very warm summer.—1821.—Do. do.

1822.—A very hot and dry summer—heavy dews.

1823.—A cold, wet, cloudy summer—last of Aug. and Sept. warm and dry.

1824.—A cold and wet summer.

Register of the flowering of Chesnut trees for eleven years.

1816, Chesnut	trees	were	in	full	bloom	July 22,
1817,	"	"	"	"	"	" 17,
1818,	"	"	"	"	"	" 8,
1819,	"	"	"	"	"	" 2,
1820,	"	"	"	"	"	" 3,
1821,	"	"	"	"	"	" 1,
1822,	"	"	"	"	"	June 29!!!
1823,	"	"	"	"	"	July 7,
1824,	"	"	"	"	"	" 10,
1825,	"	"	"	"	"	" 2,
1826,	"	"	"	"	"	June 27!!!

Remarks.—1816.—A cold and dry summer.
1818.—A warm summer.—1819.—Do. do.

1820.—A very warm summer.—1821.—Do. do.
1822.—Very hot and dry.
1823.—Cold and wet.—1824.—Do. do.
1825.—Warm and dry.
1826.—Very hot and dry.

ART. IV.—*On a Larva, liberated* σuν Oυρω; *by* JER. VAN RENSSELAER, M. D. *Corresponding Secretary of the Lyceum of Natural History, New York.*

(READ BEFORE THE LYCEUM.)

A few English words have been translated into Greek.—*Editor.*

IT must be well recollected that some months ago, I laid on the table, as a donation, a small vial, received from a respectable physician, one of our associates, labelled "Larvæ, passed σuν Oυρω Γυναικοσ αʃαμου." The larva was in spirits, and may thus be described. *Body*, rather more than an inch in length, about a line and an half in breadth; glabrous, translucent, light clove brown color cylindrical, tapering gently at each extremity; consisting of twelve articulations with the head. *Head*, small and long. The *last*, or anal articulation of the body, small, acute, and terminated by two short processes. *Legs*, six.

At the time this specimen was added to our Cabinet, some doubt existed as to the correctness of the statement respecting the manner in which it had been obtained. Its size certainly could present no obstacle.

It is a well established fact, that animals have issued from various parts of the human frame, however much the idea may have been ridiculed. But scepticism in science is daily yielding to observation, and the investigations of practical men are clearing away much of the rubbish that popular belief and prejudice have placed in the way of naturalists. Facts, well authenticated and indisputable, are now received as scientific records, which a few years ago would have startled the best informed minds of the day; whence we are led to hope that science will continue to advance, and unfold to us more of those hidden operations of nature, which are yet mysteries to us, and seem now inexplicable.

A case similar to the one now under consideration, is recorded in the valuable work of Messrs. Kirby and Spence on Entomology,* which I transcribe.

A medical friend of mine, says one of the authors, at Ipswich, gave me this winter an apode larva, passed συν Ουρω by a person of that place, which I now preserve in spirits, and can show you when you visit me. It appears to me to belong to the *Diptera* order, yet not to the fly tribe (*muscidæ*) but rather to the *Tipulida*, with which, however, it does not so entirely agree as to take away all doubt. It is a very singular larva, and I can find none in any author that I have had an opportunity of consulting, which at all resembles it. That you may know it, should you chance to meet with it, I shall describe it. *Body*, three-fourths of an inch in length, and about a line in breadth; opaque, of a pale yellow color, cylindrical, tapering somewhat at each extremity; consisting of twenty articulations without the head. *Head*, reddish brown, heart-shaped, much smaller than the following joint, armed with two strong unguiform mandibles, with a biarticulate palpus attached exteriorly to the base of each. These mandibles appear to be moved by a narrow black central tendon under the dorsal skin, terminating a little beyond the base of the first segment; besides these are four others, two on each side of it, the outer ones diverging, much slenderer and very short. The last or anal joint of the body very minute; exerting two short filiform horns, or rather, respiratory organs. I could discover, in this animal, no respiratory plates, such as are found in the larvæ of muscidæ, nor was the trachea visible. When given to me, it was alive, and extremely active, writhing itself into various contortions with great agility. It moved, like other dipterous larvæ, by means of its mandibles. Upon wetting my finger more than once to take it up when it had fallen from a table upon which it was placed, the saline taste with which it was imbued was so powerful, that it was sometime before it was dissipated from my mouth.

Man, wonderfully and fearfully made, is heir to ills unknown to most of us—among which may be enumerated those arising from punitive insects, that "bore into his flesh, descend into his stomach and viscera, derange his whole system, and thus often occasion his death,"—of which several instances are related in the work above mentioned. I am convinced that many of those village tales that excite derision at the

* Vol. I. p. 139.

moment in most but the unfortunate sufferer, would if thoroughly investigated, and plainly recorded, shed light, when properly collected and compared, on many of the mysteries that now perplex us.

In the valuable collection which our learned member, Dr. Mitchill, has just deposited in our cabinet, is a vial containing six (of thirty) larvæ vomited up by a girl seventeen years old. She was the patient of a late respectable physician of our city, and had "suffered severely, for eighteen months, from spasmodic and nervous affections."

Abundant evidence has been adduced, say Messrs. Kirby and Spence, to establish the fact beyond all controversy, that the meal worm, (*Tenebrio Molitor L.*) whose usual food is flour, has frequently been voided by human beings* and in one instance is stated to have caused death. How these grubs got into the stomach, unless the eggs were swallowed in some preparation of flour, it is difficult to say. But that the animal should be able to sustain the heat of this organ, so far exceeding the temperature to which it is usually accustomed, is the most extraordinary fact of all.

Dr. Martin Lister, so well known to geologists, was also, it seems, an attentive observer in his profession, and has recorded† the case of a girl who voided three hexapod larvæ similar to what are found in the carcasses of birds.

In the German Ephemerides‡ is related the case of a girl, from an abscess in the calf of whose leg crept black worms resembling beetles.

The larvæ of some beetle, it seems, have been ejected from the lungs. Four, of which the largest was three fourths of an inch long, were discovered in the mucus expelled after a severe fit of coughing by a lady afflicted with a pulmonary disease; and similar larvæ of a smaller size were once afterwards discharged in the same way.||

No one would suppose that *caterpillars* which feed upon vegetable substances, could be found alive in the stomach. But a case is recorded in the Phil. Trans. by Lister, of a boy who vomited up several, which had sixteen legs. The eggs,

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* Edinb. Med. and Surg. Journ. No. 35, 42, 48.—Phil. Trans. Vol. 3.—Derham Physic Theol. 378.

† Phil. Trans. 1665.—Shaw's Abridg. II.

‡ Mead, Med. Sacr. 103.

|| London Medical Review, Vol. v. 340.

it is observed, might have been eaten with salad, and enough of the vegetable might have been retained to support them when hatched.

Linnæus mentions that the caterpillar of a moth (*Cranibus Pinguinalis F.*) has also been found in the stomach. A case is related by Angelinus and Alsarius,* who give the figure, of a caterpillar of great length, said to have been voided from the nostrils of a young man long afflicted with dreadful pains in the head.

It is well known that the gad-fly, (*Æstrus L.*) sorely annoys cattle and other quadrupeds—but it is not generally known that there is a species appropriated to man. Its existence has been unnoticed by entomologists, at least in books, since Gmelin's edition of the Systema Naturæ, until Humboldt and Bonpland mentioned, that, to the myriads of musquitos, which render uninhabitable a great and beautiful portion of the torrid zone, may be added the *æstrus hominis*, which deposits its eggs in the skin of man, and causes tumors.† Gmelin mentions it on the authority of the younger Linnæus, and says that it remains beneath the skin of the abdomen six months, penetrating deeper, if disturbed, and sometimes occasioning death. Even the gad-fly of the ox, leaving its proper food, has been known to deposit its eggs in the jaw of a woman, and the bots produced from the eggs finally caused her death.‡

Other flies of various kinds thus penetrate into us, either preying upon our flesh, or getting into our intestines. Lewenhock|| mentions the case of a woman whose leg had been enlarged with glandular bodies for some years. Her surgeon gave him one he had cut from it, in which were several maggots; these he fed with flesh till they assumed the pupa, when they produced a fly as large as the flesh-fly.

A patient of Dr. Reeve, of Norwich, (England,) after suffering great pain, for some time, was at last relieved by voiding a considerable number of maggots, agreeing with the larvæ of the muscida domestica minor of De Geer.§

Azara mentions that in Paraguay he has known instances of persons, who, after having bled from the nose in their sleep,

* De verme admirando per nares egresso.
† Essai dur le geograph. des plantes, 136.
‡ Clark in the Linnean Trans. Vol. III.
|| Epistles, 1687.
§ Edinb. Med. and Surg. Journ.

were attacked with the most violent head aches; and only received relief when several great maggots, the offspring of the flesh-fly, issued from their nostrils.

In Jamaica a large blue fly hovers around the sick, and is with difficulty prevented by nurses from depositing eggs in the nose, mouth, and gums of the invalids. Lempriere records* the case of a lady, who after recovering from fever, fell a victim to the maggots of this fly, which from the nose, found their way through the os cribiforme into the cavity of the skull, and afterwards into the brain.

The larvæ of the *Elophilus pendulus F.* a fly peculiarly formed for inhabiting fluids, has been found in the stomach of a woman.†

Bonnet relates‡ that he had seen the certificate of an English physician, stating that a girl, who had by prescription of a quack, swallowed some *sow bugs* alive, threw up a prodigious number of them, of all sizes, which must have bred in her stomach.

In a *Memoire Apterologique*, Hermann gives the figure of an *Acarus marginatus* seen running on the corpus callosum of the brain of a patient, at the military hospital at Strasburgh, just as the pia mater was separated. He adds, that it is not the first time insects have been seen in the brain. He quotes C. Gemma, who says, that, on dissecting the brain of a woman, there were found abundance of vermicles and punaises.

It is well known that beans and other extraneous bodies often form a nucleus for stones in the bladder—and it is not more wonderful that a larva should be found in that viscus than that a bean should have germinated there—and that fact is sufficiently established.

The late Dr. Stringham, Professor in Columbia College, has recorded in the New York Medical Repository, (Hex. I. Vol. 6, p. 262,) the case of a lady, whose long sufferings had so "enfeebled her health that it was thought death alone could alleviate her miseries, but who was relieved and cured by the passage of a great number of non-descript insects. They were three-fourths of an inch long; the back covered with a

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* On the Diseases of the Army in Jamaica.
† Phil. Mag. IX.
‡ Vol. V.

firm cartiliginous substance, and to the inferior part of each body were attached a considerable number of legs." Dr. S. "considers them to belong to the order of vermes, molusca, and to that genus termed Actinia." His paper is accompanied by drawings of them.

Dr. Crumpe has published in the sixth vol. of the Transactions of the Royal Irish Academy, a case very similar to the above. Another, very analogous, has been inserted by Dr. Pascalis, in the seventh vol. of the Med. Repository, p. 342.

Dr. John Archer, of Maryland, communicated to Dr. Mitchill of this city, in 1808, an instance of his opening a tumour, and "extracting from it a worm eight or nine inches long, which appeared to be like a lumbricus, and alive." Med. Repos. vol. XII, p. 367.

Dr. Hazard, of S. Kingston, Rhode Island, while attending Mr. S. Chappel, (of that town,) aged about 70, "while viewing attentively the tumour, discovered an undulating motion, like that arising from the movement of some living creature. He opened the tumour, and on examination with a probe, he raised up and immediately extracted a worm, which bore an exact resemblance to the lumbricus, was about nine inches in length, and very active. The phenomenon was witnessed by a large number of respectable characters." See also Med. Rep. Hex. III, vol. 2, p. 388.

I trust that these, and the other instances related by the authors before mentioned, will at least establish the possibility that larva may pass from the urethra or bladder—and that, although uncommon, it does occasionally occur.

For accounts of larvæ voided through natural passages of the human body, I may refer to Rudolphi Entozoa, Vol. II, p. 164–5.

Art. V.—Notice and analysis of "*A Description of Active and Extinct Volcanos, with remarks on their origin, their chemical phenomena and the character of their products, as determined by the condition of the earth, during the period of their formation; being the substance of some lectures delivered before the University of Oxford, with much additional matter; by* Charles Daubeny, M. D., F. R. S., F. G. S., and Col. Phys. Lond. &c. &c., and Professor of Chemistry and Fellow of the Magdalen College, Oxford. 1 Vol. 8vo. London, 1826."

In the last number of this work, we gave, principally from the British Journals, an analysis of the elaborate and very able work of G. Poulett Scrope, Esq. on Volcanos. It would perhaps, be most natural to give next, some account of his more recent and not less interesting volume, on the extinct volcanos of France, &c. But this notice we shall, for the present defer, to make room for the work of Prof. Daubeny, which, although entirely independent of Mr. Scrope's in its origin, has followed close upon its track; is like that an original elementary treatise on volcanos, and although differing from Mr. Scrope's work in some points, conducts us in general, to similar conclusions.

Professor Daubeny was before advantageously known, especially by his Sketch of the Geology of Sicily,* and by other valuable productions. He had qualified himself for his survey of volcanos and their phenomena, by attending the usual courses of lectures, especially at Edinburgh, where he was a pupil of Prof. Jameson.

At this time, (the winter of 1816—17,) his mind was particularly directed to the long and much agitated question of the origin of the trap rocks, and he resolved not to trust to the examination of hand specimens, but to visit the "very spots," and to examine "the circumstances of geological position, as well as the nature of the rocks associated," and carefully to compare them with what we see in the trap districts—but he was then far from believing, as he now does, that "volcanos and trap rocks are, for the most part, at least, analogous formations, calculated mutually to reflect light on each other." He evidently carried with him to the investigation of this

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* See Vol. X, p. 230 of this work.

question, all the science which was necessary to his undertaking—with a spirit of careful and accurate examination, and a capacity for generalization, which enabled him to make the best use of what he saw. His observations were made, principally from 1819 to 1823. The following are the leading divisions of his work.

1. The extinct volcanos of France and Germany.

2. The volcanic districts of Hungary, Italy, Sicily and the Lipari islands, including the active as well as dormant and extinct volcanos of those countries—all the important points of which, he examined in person.

3. From the best authors, he describes the volcanos of other parts of the world, including the islands.

4. The fourth division or lecture is devoted to general inferences respecting volcanic phenomena.

In his introduction, Professor Daubeny states the distinction between active and extinct volcanos—the former including all those which have been eruptive at any time since the existence of authentic records—the latter those that have, within the same limits of time, exhibited no signs of activity, although incontestably of the same origin.

Thus, although a mountain should not exhibit a crater and the usual figure and stratification of a volcano,—if its materials have "a vitreous aspect and fracture together with a cellular structure—cells generally empty and elongated in the same direction and if they have a glazed internal appearance" there need be no hesitation in pronouncing that the materials are of volcanic origin.

All volcanic rocks may be included under

1. Trachyte,
2. Basaltic lava.

1. Trachyte—(from the Greek τραχὺς) so denominated from the harsh earthy feel which it often possesses—" is essentially composed of crystals of glassy felspar, often cracked, which are imbedded in a basis generally considered as being itself a modification of compact felspar. To this are sometimes superadded crystals of hornblende, mica, iron pyrites, specular iron and more rarely augite and magnetic or titaniferous iron."

2. Basaltic lava—" appears to be some modification of basalt—consisting essentially of augite, felspar and titaniferous or magnetic iron generally accompanied with olivine and sometimes with hornblende."

Although the ingredients are too intimately mixed to allow of our always ascertaining their nature by inspection—it can always be done by the blow pipe—for trachyte melts into a white enamel whatever may have been its color, while basalt after fusion, retains always its original color.

Felspathic lava is therefore, in the language of our author, synonymous with trachyte, and augite lava with basaltic lava.

The only essential ingredient of trachyte appears therefore to be felspar while basalt always contains augite.

1. *Extinct Volcanos of France and Germany.*

Under this division of Professor Daubeny's work, we shall not enter into much detail, because, should we be able on a future occasion to give some account of the separate work of Mr. Scrope on the extinct volcanos of France and Germany &c. we shall necessarily travel over the same ground and in doing it we can if necessary revert to the present treatise.

We believe much philosophical scepticism formerly existed with respect to extinct volcanos. They were vaguely referred to, but without decisive proof of their real volcanic origin, and many persons very imperfectly qualified to judge of such questions, were sufficiently inclined to infer the existence of volcanos of former ages, wherever they saw a conical hill or almost any hill with a hollow on its summit, and porous stones of whatever kind, were referred to a similar origin. It was a very imposing and sublime idea, that volcanic fire, still active in our planet, and still bursting forth in many places, with destructive energy, had, in ages long past, erected agencies still more extensive—covering provinces with ruins, and operating even in the bed of the primeval oceans. The speculation seemed however to claim quite as much affinity with poetical as with philosophical conceptions, and it was not till the middle of the last century that the subject of extinct volcanos began to be investigated with accuracy and skill.

The much disputed region of Auvergne, Velay and Viverais, in France, has been often visited, and examined by able geologists, and we believe that within a few years past, no one of them has left that region, without being convinced that it is of volcanic origin. The celebrated geologist D'Aubuisson visited the country in question, with the strongest belief that he should find this district of Neptunian origin, but he returned a convert to the opposite opinion; a change the more credit-able to his candor and to the vigor of his mind, because he had before published an able and interesting treatise, to prove that basalt, and especially the basalt of Saxony, was of aqueous formation.

The volcanic district of France lies upon the river Rhone, nearly in the angle formed by it with the Mediterranean, and covers an area nearly square, of from forty to fifty leagues in diameter.

We have never visited that country, but the evidence of its volcanic origin exhibited by Mr. Scrope and Professor Daubeny confirming, extending and giving precision to the observations of many previous writers, leaves not the shadow of a doubt, that the tremendous subterraneous agency of fire has covered this fine country with floods of molten rock ; no more doubt indeed, than that similar events have happened at Vesuvius, Cotopaxi and Ætna.

Being possessed of a fine series of specimens, from this very region, furnished to the cabinet of the American Geological Society by our celebrated geologist, Mr. William Maclure—we sit down with these specimens—with the full descriptions of the authors whom we have just named and with the noble atlas—geological—geographical and picturesque, of Mr. Scrope, illustrating the striking features of this interesting region, and while we feel the fullest conviction that their conclusions are substantially correct, we can easily imagine that we see the floods of lava, pouring from the now quiet and cold craters, and that the skies of France were once dimmed by the clouds of volcanic ashes, as those of Italy are at the present day.

Craters, regularly formed, often entire, sometimes with the thin and scorified edge of the lip in fine preservation, and occasionally of vast dimensions; here, black, rugged and scathed with fire, there, overgrown with trees and there, filled with water forming lakes ; currents of lava, lying where they flowed from the crater, or where they burst from the side or foot of the ruptured mountain, extending many miles and many leagues, traceable directly to their parent mountain, winding along the gorges and the sinuosities of the vallies, now and then diverted from their course by rocks, hills and other obstacles ; sometimes damming up rivers, whose courses they have crossed or obstructed, and thus forming lakes of considerable dimensions ; exhibiting all the varieties of lithoid lava, from that which is compact and rock-like, to that which is porous and vesicular in an incipient or in a prevailing degree ; crowned or mixed with slag, scoriæ, pumice, olivine and other exuviœ of known and active volcanos; displaying frequently a structure now spherical, ovoidal and concentric, now prismatic and columnar, and fronting streams and bounding vallies with ranges of columns, equalling or rivalling the regularity of the famous colonnades of Fingal's cave, and the Giant's Causeway; these are a few of the most striking features of these countries, which are so affluent in proofs of their igneous origin, that there is nothing needed but to select carefully and judiciously, those proofs which will be the most decisive, especially with respect to minds not familiar with such contemplations.

The volcanos of the Auvergne, &c. are regarded as of different ages; some appear to have been active before the formation of the present vallies, and some since; where the currents of lava have been cut through, by those causes which formed the present vallies, they are obviously older than the vallies, and where these currents have flowed into vallies, beds of rivers, &c. they are as obviously of a more recent date.

Although the local geographical names may be supposed to allude to the former character of the country as Auvergne, (Avernus,) Valleé d'Enfer, &c. still, it is thought that these names convey no allusion to historical events, but rather to the actual appearance of the surface.

"Indeed, (says Prof. Daubeny,) the streams of lava are often so little decomposed, so partially covered with vegetation, that we imagine they must have been formed within the limits of authentic history. The records, nevertheless, of the eruptions are no where to be found, and the evidence we are in quest of can be collected, it would seem, only from the volume of nature, which in this instance speaks a language so intelligible."

"The high antiquity of the most modern of these volcanos is indeed sufficiently obvious. Had any of them been in a state of activity in the age of Julius Cæsar, that general, who encamped upon the plains of Auvergne, and laid siege to its principle city, could hardly have failed to notice them. Had there been even any record of their existence in the time of Pliny or Sidonius Apollinaris, the one would scarcely have omitted to make mention of it in his Natural History, nor the other to introduce some allusion to it among his descriptions of this his native province.

"The case is even stronger, when we recollect that the poet's residence was on the borders of the Lake Aidat, which owed its very existence to one of the most modern volcanos; and that he was aware of the nature of such phenomena, appears from a letter extant of his addressed to the Bishop of Vienne, in which, under the apprehension of an attack from the Goths, he informs him that he is going to enjoin public prayers, similar to those which the bishop had established, at the time when *earthquakes demolished the walls of Vienne, when the mountains opened and vomited forth torrents of inflamed materials, and the wild beasts, driven from the woods by fire and terror, retired into the town, where they made great ravages.*"

Although the formation of these volcanic regions was anterior to the records of history, it was evidently in the most recent portions, posterior to the existence of organized beings, which are found imbedded in the volcanic tufa.

"The tuff in some places, as at Salers, is composed of minute fragments so highly charged with oxide of iron, that it has much the appearance of a ferruginous sandstone. In this state it sometimes contains impression of leaves and branches of trees, which appear in no respect mineralized, but carbonized and reduced to an impalpable powder by the ordinary process of decay. In other cases, where the tree has wholly disappeared, the hollow which it occupied in the midst of the tuff still remains. This circumstance tends in a still greater degree to identify the tuff of Auvergne with the trass of the Rhine volcanos.

"The shells that are found at Gergovia near Clermont, and at Aurillac in Cantal, both belong to the fresh water formation, and the recent discovery of bones belonging to the Mastodon, and to extinct species of several existing genera of animals, in the volcanic tuff of Mount Perrier, near Issoire, completes the resemblance with the rocks of the Paris basin.

"This discovery is announced in the Bulletin des Sciences for November 1824, p. 328, in an extract from a memoir read by M. le Comte Laizer at the annual meeting of the Philosophical Society of Clermont in Auvergne. Between Champeix and Issore, an elevated platform of basalt and tuff occurs, the latter composed of fragments of pumice and trachyte cemented by the usual argillaceous paste. In this aggregate, are the bones of no less than twenty extinct species of Mammalia, several of which have been pronounced by Cuvier to be new.

"Among the Pachydermata are, the Mastodon, Elephant, Rhinoceros, Hippotamus, Tapir.

"Ruminantia—two species of Ox, like the Auroch, two species of Stag,—all four extinct.

"Rodentia—a Beaver.

" Carnivora—two new species of Bear, three species of the G. Felis like the Panther, one species of the Hyæna, one species of Fox, one species of Otter,—all of them new.

" Besides the above, occur bones of Birds, and impressions of Fish.

" Drawings of these bones are announced as about to be published by subscription."

Speaking of another place, M. Daubeny says :—

" A limit on the other hand is set to the age that can be assigned to this volcanic breccia, by the circumstance of its being superposed on strata, containing fresh water shells, and bones of mammalia* similar to those of the basin of Paris. Hence the eruptions to which the materials of this tuff owe their existence, though anterior to the period at which the vallies were excavated, must date from one subsequent to the formation of the tertiary rocks found in that neighborhood."

" Thus during the period immediately antecedent to that at which man and other existing species of Mammalia first came into being, at a time when the lower parts of the country were still under water, but the higher had become peopled with various tribes of land animals, the neighborhood of the Puy appears to have been agitated by volcanos, which overspread the country with their ejected materials, caused the destruction of the animals that existed there, and according to M. Roux, obstructed the drainage of the district, and consequently raised the waters to a still higher level than before. The ejected materials, intermixed with fragments of older rocks washed down at the same time from the neighboring high ground, were deposited at the bottom of the water, forming the immense masses of tuff which now cover the valley of Puy, and during the latter part of the period occupied by this process, the same volcanic forces elevated from the midst of the then existing lake the trachytic rocks which constitute the ridge of Mont Mezen.

" But besides these traces of volcanic action at a period antecedent to the formation of the valleys, the neighborhood of the Puy, no less than the province of the Vivarais which bounds it on the south-east, exhibits also decided evidence of post-diluvial eruptions having taken place.

" West of the town of Puy is a series of little volcanos, amounting according to M. Bertrand Roux to more than a hun-

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* Cuvier has ascertained that they belong to the genus Paleotherium and Anthracotherium; the former contained in a gypseous deposit similar to that of Montmartre; the latter in a calcareous rock, in which were found fresh water shells. The same bed inclosed bones of other Mammalia, and portions of the shell of the Turtle.

dred, the two most remarkable of which are the Lake de Bouchet and the crater of Bar. The former, which is situated near the villages of Cayre and Bouchet, is of an elliptical form, and without any outlet. Its depth is about ninety feet, and its greatest diameter two thousand three hundred. The character of the rocks in its neighborhood corresponds very well with the idea of its volcanic origin. The crater of Bar is placed on an isolated mountain in the midst of granite, forming a truncated cone about twenty thousand feet in circumference at its base, and eight hundred and thirty in height. It is composed entirely of *lapilli* and scoriform lava, and on its summit is the crater, which is almost perfect, one thousand six hundred and sixty feet in diameter, and one hundred and thirty in depth. It appears that a lake once existed there, but it is now nearly dried up."

That the changes in the rocks have been scarcely appreciable within the limits of history is considered as proved by the fact that the rock on either side of the old Roman roads, none of which can be less than one thousand and three hundred years old, has undergone since that period, scarcely any sensible decay.

Volcanos of Germany.

With this slight notice of the volcanos of France, we pass to those of Germany.

"Although no active volcanos are found in any part of that extensive country, and the recognition of those which are extinct dates only from the last century, yet those who have visited the spots themselves will feel no more doubt as to their having once existed, than an American who had witnessed the burning mountains of his own hemisphere, but had never heard of those in Europe, would entertain with respect to the real nature of Vesuvius, if landed at its foot when it chanced to be in a tranquil state.

"This remark applies to no case more completely than to that of the rocks which occur in a district commonly known by the name of the Eyfel, situated between the Rhine and the present frontier of the Netherlands.

"This country is bounded on the south-east by the Moselle, on the north-east by the Rhine, on the west by the Ardennes and the other mountains round Spa and Malmedi, and on the south by the level country about Cologne.

"The fundamental rock which comes to view is clay-slate, associated with greywácké, and with a saccharoid magnesian limestone containing trilobites and other petrifactions, which stamp it as belonging to the transition series.

"These rocks in a few places support horizontal beds of what appears to be the second or variegated sandstone formation. Scattered however over the greater part of the district alluded to, are a number of little conical eminences, often with craters, the bottoms of which are usually sunk much below the present level, and have thereby in many cases received the drainage of the surrounding country, thus forming a series of lakes, known bv the name of "Maars," which are remarkably distinguished from those elsewhere seen by their circular form, and by the absence of any apparent outlet for their waters.

"Steininger, a geologist of Treves, who has published the most circumstantial account of this district that has yet appeared, distinguishes these craters into three classes.

"The first includes those properly speaking known by the name of "Maars,"—volcanos which have ejected nothing but loose fragments of rock with sand and balls of scoriform lava. In this class are:—

1. The Lake of Laach.
2. The Maar of Ulmen.
3. Three Maars at Daun.
4. Two at Gillenfield.
5. One at Bettenfield.
6. One at Dochweiler.
7. One at Walsdorf.
8. One at Masburck.

No. 6 and 7, however, have fallen in.

"The second class is distinguished from the preceding in consisting of those which have ejected fragments of slag, sometimes loose, and sometimes cemented together into a paste. Of this denomination are:—

1. Three Craters at Gillenfield.
2. Two at Bettenfield.
3. One at Gerolstein.
4. One at Steffler.
5. Two at Boos.
6. One at Rolandseck.

"The third class includes such volcanos as have given out streams of lava as well as ejections of loose substances. Of these latter we may mention:—

2. Two at Bertrich (one very small.)
3. One at Bettenfield (the Mosenburg.)
4. One at Ittersdorf.
5. One at Gerolstein.
6. One at Ettringen.

"Thus the whole number of craters in the Eyfel district, including those of the same date that are scattered along and near the left bank of the Rhine within the limits marked out, appears to be no less than thirty.

"The sides of these craters, wherever their structure was discernible, appeared to me to be made up of alternating strata of volcanic sand and fragments of scoriform lava, dipping in all directions away from the centre at a considerable angle, and the same kind of material has in many instances so accumulated round the cones, as to obliterate in great measure the hollow between them, and to raise the level of the country nearly up to the brim of the craters.

"The formation of these cones seems likewise to have been in some instances followed by an ejection of substances of a pumiceous character, and the same kind of material, (whether derived from these or from some antecedent eruptions, will be afterwards considered,) is spread widely over the country bordering on the Rhine, either in loose strata alternating with beds of a loamy earth, derived probably from substances in a minute state of division thrown out by the same volcano, and mixed up into a paste with water; or else forming masses of considerable thickness, in which the fragments of pumice are intermixed with the latter substance, and constitute together with it a coherent mass known by the name of Trass.

"The volcanos of the Eyfel are also, as above noticed, accompanied by streams of lava, but these have not in my opinion, like the generality of those seen elsewhere, been satisfactorily traced to the craters, but seem rather to have flowed from the sides or base of the mountains with which they are respectively connected.

"These Coulées, like the volcanic cones themselves, are sometimes almost buried under heaps of matter subsequently ejected, so that in the lava of Neidermennig, the quarry, from whence the millstones are obtained, is worked at a depth of eighty feet from the present surface. They are in some cases analogous to the ejections of existing volcanos, but at others they possess more of a basaltic character, being freer from cells than true lavas generally are, although it can be demonstrated that they too are (geologically speaking) of modern formation, inasmuch as they follow the inclination of the vallies, and must therefore have flowed since the latter were excavated."

In order justly to appreciate the full extent of evidence for the volcanic character of the countries on the Rhine, it is necessary to go through with the details of description, which are exhibited by Professor Daubeny, which at present it is not in our power to do. Suffice it to say, that the trass or tarras, of the Rhine, so esteemed as a subaqueous cement, is a volcanic production, and that the evidence is generally of the same nature as that which relates to the volcanic district of France. The trass is regarded by all as pumiceous conglomerate; it exists in vast quantities, but geologists are not exactly agreed as to the mode of its deposition—whether it is an ejection from craters, in the form of ashes, or a muddy eruption like those of South America.

Hungary.

Professor Daubeny visited Hungary as well as the volcanic regions on the Rhine, and he has availed himself of the elaborate work of Beudant, which describes in full detail this interesting country. In the opinion of our author, Hungary is the country which should be principally examined in studying the natural history of trachyte, which plays so important a part in the ancient volcanos—as trachyte appears to be little known in this country, we will quote the account of this substance which Prof. Daubeny has abstracted from Beudant, and we do it with the more satisfaction as we are in possession of Beudant's work, and an extensive suite of trachytic rocks, from Hungary, which were put up at Vienna, and labelled with great care, and with a very judicious selection of excellent characteristic pieces.* We have compared them with the following description, and have great reason to be satisfied with its accuracy.

Trachyte includes five varieties:—

1. Trachyte properly, so called.
2. Trachytic porphyry.
3. Pearl stone.
4. Millstone porphyry.
5. Trachytic conglomerate.

"Trachyte, properly so called, is characterized by its porphyritic structure, by the scorified and cellular aspect which it has such a tendency to assume, by its harsh feel, and by the presence of crystals of glassy felspar, generally cracked, and sometimes passing into pumice. Besides these, which may be regarded as essential to its composition, crystals of mica and hornblende are

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* They have been added by, Col. Gibbs, to the great collection purchased of him for Yale College, in 1825.

often present, and all these minerals are either confusedly united without any apparent *cement*, or by the intervention of a paste of a felspathic nature, sometimes compact, and sometimes cellular. This paste is generally light colored, though different shades of red and brown are sometimes communicated to it by the presence of iron, and there is one variety in which the paste is perfectly black and semivitreous, intermediate in its characters between pitchstone and basalt, but distinguished from either rock by melting into a white enamel. Augite is sometimes present, and grains of titaniferous iron are often discoverable, but olivine rarely, if ever, occurs, and therefore appears to be the only mineral which has any claim to be considered as peculiar to basalt.

"The second species, called by Beudant Trachytic Porphyry, is distinguished from the preceding by the general absence of scorified substances. Neither hornblende, augite, nor titaniferous iron enter into its composition, but quartz and chalcedony, which are wanting in the former, are commonly present in this species. In its general aspect it bears a much nearer resemblance to the older formations than trachyte properly so called.

"This description however applies only to the characters of the larger portion of the mass, for Mons. Beudant is compelled, in order to include all the varieties, to establish two subspecies, the one *with*, the other *without* quartz, and in both of these he notices a variety possessing a vesicular structure. The subspecies indeed, which is without quartz, even passes into pumice. Many varieties of Trachytic Porphyry contain a number of very small globules, which seem to consist of melted felspar, having often in their centre, a little crystal either of quartz or of mica. The assemblage of these globules, leaving minute cells between them, sometimes gives to the rock a scoriform aspect. The chalcedony often occurs in small geodes, and sometimes intimately mixed with the paste in which the crystals are imbedded.

"Trachytic porphyry also appears to pass by imperceptible gradations into the next species, pearlstone which is characterized by the vitreous aspect generally belonging to its component parts. It is evident, that this definition includes pitchstone and obsidian, but these are of rare occurrence in Hungary, the great mass of this formation being composed of the mineral called pearlstone, some varieties of which pass into pumice.

"In its simplest form, this rock presents an assemblage of globules, varying from the size of a nut to that of a grain of sand, which have usually a pearly lustre, and scaly aspect, and are set, as it were, one upon the other, without any substance intervening.

"From this, the most characteristic variety, the rock passes through a number of gradations, in which its peculiarities are more or less distinctly marked. In some varieties the globules are destitute of lustre, and exhibit at the same time sundry alterations in their size, structure, and mode of aggregation, till at length they entirely disappear, and the whole mass puts on a stony appearance, which retains none of the characters of pearlstone. On the other hand the globules, becoming less distinct either resolve themselves into a paste resembling enamel, very fragile, in which separate portions approaching to a spherical form are indistinctly visible, or into a more vitreous and more homogeneous mass, which is generally black, and presents all the characters of pitchstone or obsidian. Among these latter varieties is one which resembles the marekanite of Kamschatka.

"Sometimes globules consisting of felspar occur in the rock, which are either compact or striated from the centre to the circumference, and these are sometimes so numerous that the whole mass is composed of them. Various alternations occur between the glassy and stony varieties of the pearlstone, sometimes so frequent as to give a veined or ribboned appearance to the rock, at others curiously contorted as though they had been disturbed in the act of cooling.

"Lastly, all these varieties occasionally present a cellular, porous, spongy, and fibrous aspect, and pass into pumice. With respect to their chemical characters, it may be sufficient to remark that the vitreous varieties of pearlstone usually effervesce under the blow-pipe, but the stony do not. These rocks often contain geodes of chalcedony and opal, the former existing in the more vitreous, the latter in the more stony or felspathic portions. The opal is commonly opaque, but is occasionally met with more or less translucid.

"The fourth species is distinguished for its hardness and cellularity, qualities which have caused it to be employed all over Hungary for the purpose of millstones, from whence the name of Millstone Trachyte has been applied to it by Beudant.

"Unlike the other rocks comprised under the same generic term, it abounds in quartz, or in silex under some one of its modifications, and in proportion as the latter earth is more or less abundant, the substance puts on the characters either of hornstone or of clay porphyry. The paste is always dull and coarse looking, its colors vary from brick-red to greenish-yellow, its fracture is generally earthy, its hardness very variable, but usually considerable. It contains crystals of quartz, of felspar, lamellar, and sometimes glassy, and of black mica, imbedded. Jasper and hornstone also occur in nests, or in small contemporaneous veins very abundantly disseminated, and siliceous infiltrations, posterior to the formation of the rock, seem likewise to occur among the cells which are every where distributed.

"In examining these rocks with a glass, we discover a multitude of little globules analogous to those in the pearlstone, which seem to be of a felspathic nature, and when broken, are found to contain in their centre a little crystal of quartz, or a speck of some siliceous substance.

"These globules in some cases compose the whole substance of the paste, in others they are held together by a sort of hardened clay, which here and there resembles porcelain-jasper. Notwithstanding these distinctions, there is a greater degree of uniformity in the characters of this, than in those of the other species of trachyte, and the most obvious differences between the several parts of this formation relate to the size and direction of the cells, which are sometimes so small and narrow, as to give to the rock a fibrous character, sometimes of considerable size, in which case they are in general coated internally with crystals of quartz.

"The fifth and last species comprehended by Beudant under the generic term of Trachyte, consists of those heaps of pumice, and other loose materials, that occur agglutinated together on the slopes and at the base of the rocks belonging to the four preceding classes. Although the prevailing constituent is pumice, every variety of rock found in the neighboring hills is met with amongst the fragments. The latter vary extremely in size, as well as in the mode of their aggregation; the cement which unites them is often of a porphyritic character, hardly distinguishable from the fragments themselves. Like them it often contains crystals of felspar, mica and hornblende, and sometimes grains of titaniferous iron are diffused through it, or it is colored red by the peroxide of that metal.

"The fragments of pumice are united together either immediately, or by the intervention of a paste of a vitreous character resembling obsidian, into which the pumice passes insensibly. Here and there the rock itself has become decomposed, and its destruction has given rise to beds either of a cellular nature arising from minute portions of pumice, which still preserve their fibrous texture, or (where all traces of this have been obliterated) to masses of an earthy character similar to the trass of the Rhine volcanos or the "*tripoli*" of those in Auvergne."

The trachytic conglomerate has evidently undergone decomposition in various ways. Sometimes it contains marine shells, similar to those found in the calcaire grossier of the Paris basin; sometimes the infiltration of siliceous matter has mineralized in it the stems of vegetables of a cylindrical form, often hollow, and crystals of felspar, mica, quartz, and garnet, are distributed through the substance of the mass.

It is also decomposed into alum, which is profitably extracted by the usual modes, with the addition of five per cent, of sub carbonat of potass, to make it crystalize, there not being sufficient alkali in the stone.

Opal and hyalite are found in the trachyte of Hungary.

The geological portion of the different varieties of trachyte, is stated to be constant.

1. Trachyte, properly so called, in the centre of the group.

2. Trachytic conglomerate surrounding the flanks of the mountain.

3. Trachyte-porphyry—the pearl stones and the millstone porphyry intermediate.

"The following is a synopis of the genus Trachyte, as given by Beudant.

1st Species, Trachyte, properly so called.

1st variety *granitoid*, no apparent cement, numerous crystals of glassy felspar, confusedly united; crystals of black mica; hornblende rare.

2nd, *with mica and hornblende*—these crystals abundant, and generally black; paste of compact felspar, pretty pure, and fusible into a white enamel; crystals of glassy felspar.

3d, *porphyritic*—paste of compact felspar, fusible into a white enamel; crystals of felspar, glassy, lamellar, and compact; augite more or less abundant; no mica or hornblende.

4th, *black*,—the paste black, dull, fusible into a white enamel, with black spots, more or less numerous, disseminated; crystals of glassy felspar, sometimes of augite.

5th, *ferruginous*, paste ferruginous, dull, of a red or brownish color, blackening when heated; fusible into a black or scoriform enamel; crystals of glassy felspar; numerous crystals of black mica.

6th, *earthy or domite*, paste earthy, porous, light-colored; crystals of glassy felspar rare; crystals of black mica abundant.

7th, *semi-vitreous*, (*Pseudo-basalte of Humbolt*,) paste semi-vitreous, black or brown; fracture large-conchoidal, losing its color in the fire, and melting into a white enamel.

8th, *cellular*, paste of various descriptions; contains numerous cells more or less imperfect, either round or elongated.

2d Species, Trachytic Porphyry.

1st Subspecies, *with crystals of quartz;* base of compact felspar, with or without lustre, more or less abundant, containing most commonly a great number of small semi-vitreous globules; crystals of quartz, more or less numerous; crystals of glassy felspar, generally well defined; black mica, in small hexagonal plates more or less numerous.

1st variety, *glistening*, base composed of compact felspar with an enamelled surface, easily fusible.

2nd, *semi-vitreous* (vitro-lithoide,) almost entirely composed of semi-vitreous globules, amongst which are disseminated crystals of glassy felspar, and some of quartz.

3d, *scoriform;* paste semi-vitreous and dull, porous, or with irregular and imperfect cells.

4th, *cavernous;* paste scarcely discernible; small and very numerous cells; irregular cavities of various sizes; mass infusible.

2d Subspecies, *without quartz:* base of compact felspar with or without lustre, more or less fusible before the blowpipe; small crystals more or less numerous, often with imperfect terminations, of glassy or earthy felspar; black mica in small hexagonal plates; no crystals of quartz or semi-vitreous globules.

1st variety *glistening;* base of compact felspar, easily fusible into a white enamel; small crystals of felspar, commonly of the glassy kind.

2d *dull;* base of compact felspar, dull, difficulty fusible before the blowpipe; small crystals of felspar, commonly earthy, sometimes very rare.

3d, *cellular or pumiceous;* base almost infusible, full of cells; crystals of felspar rare and indistinct.

3d Species, *Pearlstone.*

1st variety, *testaceous*, made up of an assemblage of vitreous globules more or less distinct, generally scaly (testacès) and with a pearly lustre; mica and felspar very rare.

2nd, *spherolitic.* paste of pearlstone not testaceous, with an enamelled lustre, and a grey color; numerous crystals of very brilliant black mica; glassy felspar in small crystals, ordinarily with their terminations imperfect.

3d, *pitchstone*, vitreous paste approaching to obsidian, often with a fatty lustre; crystals of glassy felspar with imperfect terminations; little geodes of chalcedony more or less numerous.

4th, *globular stony*, stony mass, composed of globules with a compact or radiated structure, semi-vitreous or altogether stony.

5th, *stony in mass.* The whole mass semi-vitreous, or altogether stony; the structure passing sometimes into porphyritic.

The Millstone Porphyry is so uniform in its composition, as not to admit of being distinguished in the manner of the preceding species; but

The 5th Species, Trachytic Conglomerate, is divided into

1st, *the conglomerates made up of the debris of Trachyte*, cemented by an earthy or more or less crystalline paste.

2d, *the conglomerates consisting chiefly of the trachyte and millstone porphyry*, rounded or angular.

3d, *the pumiceous conglomerates*, composed of fragments of pumice and obsidian, agglutinated either immediately, or by the intervention of some cement more or less earthy.

4th, *the porphyritic conglomerates*, resulting from the decomposition of the pumice.

5th, *the aluminous beds*, consisting of tufaceous or conglomerated rocks impregnated with alum."

Transylvania.

Professor Daubeny, derives his knowledge of the rocks of Transylvania from a private communication of Dr. Bouè, of whose geological labors there is a notice from the pen of Dr. J. W. Webster. See vol. 6, p. 185, of this Journal.

Unfortunately, Dr. Bouè's contemplated journey through the Bannat and the provinces of the Austrian empire as far as Trieste, was prevented by "a severe illness occasioned by the villany of a servant, who attempted to poison him in order the more readily to make off with his money and property."

In the eastern part of Transylvania there are volcanic rocks of undoubted tertiary formation.

"They are for the most part composed of various kinds of trachytic conglomerate; of which the best sections are presented along the course of the Marosch, for elsewhere a most impracticable forest of pine and oaks covers it nearly throughout. From the midst of these vast tufaceous deposits, the tops of the hills composed of trachyte, a rock which forms all the loftiest eminences, here and there emerge. Of these the most elevated is called Kelemany; the other principal ones are Fatatschion, Pritzilasso, Hargala, Barot, the hills south of Tuschnad, &c. &c. The trachyte is ordinarily reddish, greyish, or blackish; it mostly contains mica. In the southern parts, as near Tschik Sereda, the trachyte incloses large masses, sometimes forming even small hillocks, of that variety of which millstones are made, having quartz crystals disseminated through it, and in general indurated by siliceous matter in so fine a state of division that the parts are nearly invisible. The latter substance seems to be the result of a kind of sublimation, which took place at the moment of the formation of the trachyte.

"Basalts were no where observed, although black trachyte abounds. Distinct craters are only seen at the southern extremity of the chain. One of the finest observed by Dr. Bouè was to the south of Tuschnad; it was of great size, and well characterized, surrounded by pretty steep and lofty hills composed of trachyte. The bottom of the hollow was full of water. The ground near has a very strong sulphureous odour. A mile in a S. S. E. direction from this point there are on the table land two large and distinct "maars," like those of the Eyfel, that is to say, old craters, which have been lakes, and are now covered with a thick coat of marsh plants; the cattle dare not graze upon them for fear of sinking in.

"Some miles farther in the same direction is the well known hill of Budoshegy (or hill of bad smell,) a trachytic mountain, near the summit of which is a distinct rent, from which exhale very hot sulphureous vapours. The heat of the ground is such as to burn the shoes. A deposition of sulphur has taken place there, and the rock is converted into alum-stone by the action of the vapors upon the constituents of the trachyte. In this manner hollows are formed in the rock. At the base of the hill are some very fine ferruginous sulphur springs, much resorted to for various diseases by the inhabitants, who encamp near them in the open air during summer. Chalybeate sulphur springs generally abound at the base of this volcanic range, and chalybeates with carbonic acid still more. Some of these appeared as good as those of Pyrmont, and the most famous, that of Borsah, a bathing place much resorted to by the Transylvanian nobles, contains more carbonic acid than Pyrmont water itself.

"The craters last described have thrown out a vast quantity of pumice, which now forms a deposit of greater or less thickness along the Aluta and the Marosch from Tuschnad to Toplitza. Impressions of plants and some siliceous wood are likewise to be found in it, as is the case in Hungary."

In *Styria*, the volcanic appearances are not very remarkable—but there are hills of trachyte, surrounded by mantle shaped strata of volcanic tuff consisting "in general of a congeries of very minute fragments of volcanic matter which seem to have been immediately ejected from the volcano, mixed up and looseley agglutinated with small quartz pebbles. In the midst of it are fragments of cellular and compact basaltic lava, sometimes containing nests of olivine.

Italy.

Euganean Hills.—Entering Italy, by the side of Venice, and passing to the south of Padua, we come to the Euganean Hills, an isolated tract of high ground, in the midst of a level country, consisting of a trachytic formation, similar to that of Hungary, "which from its cellular structure in some cases, and its semi-vitreous aspect in others, would at once be taken for a volcanic product."

"The trachyte of the Euganean hills rests upon a calcareous rock, which appears to correspond with the chalk of Great Britain. It is called Scaglia, from its slaty structure, being disposed in thin horizontal layers. Its color is commonly white, now and then with a shade of red, and its compactness usually is quite equal to that of our hardest chalk, though softer varieties are sometimes met with.

"The points however chiefly to be insisted on, as establishing the identity of the two formations, are, the kidney shaped masses of flint disposed in beds throughout the Scaglia, as in the chalk of England, and the nature of the petrifactions that occur in it, which, from the list given in the Abbé Maraschini's late work, appear to consist of ammonites, terebratulites, and various species of the echinus family; viz. the echinoneus, galerites, ananchytes, spatangus, cidaris, nucleolites, and echinus *proper*, of Lamarck."

"Indications of volcanic action may perhaps be gathered from the springs of hot water impregnated with sulphuretted hydrogen, which gush out from the rock near the village of Battaglia, and are still in repute, as they were in the time of the Romans, for their medicinal qualities.

"Perhaps the fable of Phæton, who was said to have fallen from heaven, or to have been struck by lightning on the borders of the Po, may refer to some tradition that existed of volcanic phenomena, which may have continued here as they now do in Transylvania, long after the formation of the trachyte."

Vicentin.—This country is interesting, especially on account of the alternation and mixture of volcanic products with limestones containing organized remains, with lignites, &c. The petrifactions are such as indicate a tertiary formation, and in the hill of Bolca are contained those remarkable ichthyolites (usually called the fossil fish of Mount Bolca, near Verona,) which are so conspicuous in cabinets, and which are so interesting to the geologist. As there are fine specimens of these ichthyolites in the Cabinet of Yale College, the following passage relating to them will be interesting to those who visit that collection.

"At Monte Bolca, the only locality which I visited, the ichthyolite limestone, as it may be called, rests upon a calcareous rock with nummulites, and is covered by the same; whilst a deposit consisting of volcanic tuff lies both under and above. The alternations indeed between these two classes of deposits are often extremely numerous; at a place called Ronca alone we have in a very short compass no less than six, but the lowest volcanic bed is not tufaceous, but consists of cellular basalt. The occurrence of this substance, sometimes cellular, sometimes amygdaloidal, and sometimes even compact, interstratified with the other rocks, renders the structure of Vicentin less simple than it would otherwise be considered, and inclines one to think that streams of lava were thrown out during the formation of the tufaceous and calcareous beds. That the whole indeed of the basaltic, as well as the materials of the tufaceous rocks are referable to igneous action, I cannot bring myself for a moment to doubt, although aware that Brocchi, the first of Italian Geologists, has in his Memoir on the Val de Fassa expressed himself with some degree of hesitation on the subject."

"The presence of shells in the tuff itself, and its alternation with regular beds of unaltered shelly limestone, prove that the sandy matter and loose fragments of which this aggregate is composed, were originally deposited under the surface of water, at the period during which the calcareous beds were in the act of forming. That the accumulation of the materials of which the tuff consists was a slow and gradual process, I infer among other reasons, from a specimen in my possession, in which a rounded fragment taken from one of these beds is seen covered by serpulæ, a plain proof that the stone remained for some time under water, uncovered by any of the matter which afterwards formed above it.

"The occurrence therefore of beds of volcanic tuff alternating with strata of shelly limestones seems in this instance capable of explanation, by supposing showers of ashes and lapilli to have proceeded from some adjacent volcano, which, as they sunk to the bottom of the water then covering the face of the country, would become intermixed with the fragments washed down from the adjoining rocks, and be consolidated like mud in a stagnant pool, acquiring additional consistency in proportion to the mass of matter superimposed.

"That the volcanic action was indeed going on in this very spot, is proved by the hills of cellular lava, or of basalt, that occur in the midst of this formation, and the effects of these operations upon the tuff itself may be traced in the inclined position of its beds, so different from what would occur in a mass of matter deposited tranquilly under the surface of water.

As there is probably no locality of ichthyolites more interesting than that of Bolca, we will introduce a more particular account and description from M. Brongniart's *Mémoire sur les terrains de sediment supérieurs—calcaréo-trappéens du Vicentin*, of which we have received a copy from the author.

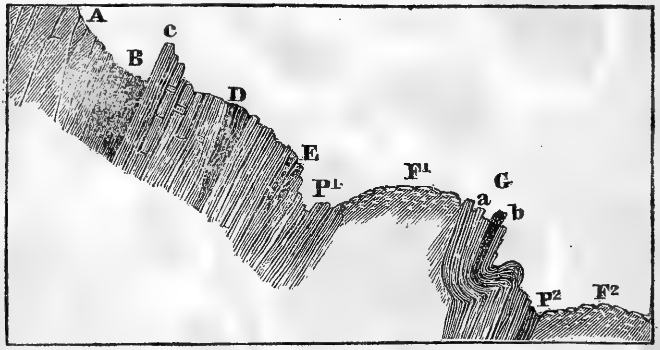
Mount Bolca.

"I am now arrived at one of the principal objects of my work, that is to say, the crisis, when I shall determine, with some probability, to what epoch of formation, the celebrated locality of fossil fish at Mount Bolca ought to be referred.

"I shall not attempt to describe this mountain, or rather this collection of very high hills; I have not studied it sufficiently to induce the hope that I could give a description of it, which would be more complete than that given by the naturalists who have made it known: but I think nevertheless, that I shall be able to distinguish the characteristic traits of the formation to which it belongs. It will suffice, therefore, to fix these characters, to give a short account of the quarry which I visited, or rather to give an explanation of the section which I have made of it.

"It is known that the quarries of ichthyolites are situated towards the summit of the hills which are to the south east of Mount Bolca, and which descend towards Vestena-Nova. In general the base of these hills towards the east, that is to say, towards the vallies of Chiampo, has appeared to me to be composed of a compact limestone, amygdaloidal, reddish and analagous in its structure to the marble known under the name of *Verona marble* or limestone, which in the Euganean mountains is evidently inferior to the trachyte and other felspathic rocks of these mountains, which include some ammonites, and which seem to me to possess the most of the characters belonging to the Jura limestone. Upon these beds of limestone, and as it were issuing from their bosom, are some very elevated and extensive hills, composed of almost all the species and varieties of trap rocks, the spilite, the basanite, the *brecciole*, which are scattered about either without any order, or in an order which I was unable to discover. These trap rocks, existing here upon a grand scale, elevated and extensive, alternate, especially, towards the highest parts of the hills, and of course with their most superficial parts, with some beds of a limestone, often calcareous or marly, which are equally extensive: this is the limestone which contains the fossil fish, and this is the limestone, of which the point is to determine the epoch of its formation. Finally, the highest summits and particularly that called *la Purga di Bolca*, are crowned with basalt, which seems of course to cover the preceding rocks, and which, in fact, does cover them very often, without any doubt. Such is the general disposition of the rocks in the mountains which compose the group of which Bolca makes the principal elevation. The following description will make known the particular disposition of these rocks in some cases.

"The ichthyolite hill which I have visited, and of which I here give a drawing, *in section*, but without exact proportions, although less high than another quarry situate upon the other side of a very deep valley, is already sufficiently elevated and probably four hundred mètres at least, above the level of the Adriatic sea, according to the barometrical measurements taken by M. Pollini, and given by M. Bevilacqua-Lazise. It presents two quarries of ichthyolites placed the one above the other, and has shown me the succession of rocks which I describe from the summit to the last quarry.



"1. The summit A, presents brown compact limestone, very much in fragments and disintegrated, but nevertheless in its stratification very distinctly inclined towards the south.

"2. In B a bed, (filon-couche) of brown basanite very much in fragments and disintegrated. This bed or vein of basanite is very extensive; we follow it with ease, as far as its position is constant and regular. A little way from the ichthyolite quarry we perceive another bed of it which in its position is absolutely similar to that of the basanite B.

"3. Below, are many layers of a compact limestone C, like that which occurs above the basanite. The layer which touches the basalt is blackish; the others are dirty white, traversed with veins of calc-spar and by fissures lined with little crystals of lime.

"The angles of the fissures of these beds are as it were rounded, and worn off or corroded on the side of the basalt; they are moreover much in fragments; their parts or natural fragments at curved surfaces have a resemblance to large almonds produced by the compression and sliding one upon another of subelliptical fragments.

"These layers, much more multiplied than the drawing represents, are almost vertical.

" 4. We come to a bed D, of a brown color, composed of curved layers, and resembling by their disposition, their structrue in the middle, &c. a stratum of concretionary limestone.

" 5. There follow afterwards some beds of marly limestone very large, very numerous, divided naturally into parallelopipedons of which the centre is blackish, and inclosing in E, more nodules of "silex cornè" more or less abundant.

" 6. Below these layers, are found those of the marly limestone or calcareous schist, hard, yellowish, compact, and very fissile, which contains the fossil fish.

" *Des dêblais abondans*" cover the lower beds here.

" 6. In descending below these *dêblais* to come to the inferior quarry, we find at first in G, some new layers of marly limestone, among which we have remarked two beds in particular. The upper (*a*,) is there, brownish, and presents some impressions of very small and almost indeterminable shells; but which have appeared to me however, to be of the genus *avicule.*

" The other bed (*b*,) larger and very hard, is full of shells, and presents the aspect of a true lumachelle. These shells as far as we are able to observe them, are nummulites, fragments of bivalve shells, and alveolites, which appear to belong to the alveolites festuca Bosc, &c.

" These two beds and the very numerous layers which accompany them make some curves which are very remarkable, and which the figure indicates.

" 7. Finally, below their contorted, and shelly layers, a second deposit P2, of ichthyolite presents itself, composed like the one above of veins or numerous fissures of marly limestone or rather of marly schist. Between these beds, divided by a multitude of fissures, traversed by veins of calc spar, are found together, the numerous fossil fish and the numerous impressions of plants which are for the most part terrestrial or fluviatile.

" Lignite in scattered masses at Montechio—Maggoire, in thin beds at Monte-Viale, presents itself here abundantly and often in beds which are very large. We have seen it in thin beds in a volcanic earthy and fusible breccia in ascending to the quarries I have just described, and we have found it in the same portion in returning from those quarries towards Vestena-Nova.

" Numerous beds, and sufficiently extensive to be quarried, occur at the foot of the isolated and basaltic cone, called *la Purga di Bolca.* These beds of lignite described by M. Bevilacqua Lazise, are inclined from the north west, to the south east, covered and intersected also by basanite (volcanic trap, B, L,) and also sometimes in immediate contact with the compact and almost prismatic basanite: it is surrounded and as it were enveloped with plastic clay, white, yellowish, or bluish; it is covered by a bituminous schist, and reposes in this place upon the ichthyolite limestone.—*Bevalacque-Lazise, page* 29 *et* 36."

Monte Cimini, Viterbo, and other places on the road to Rome, present traces of volcanic action, but not in every instance of an unequivocal character. A small lake near Viterbo, emits a sulphureous odour, and the water is agitated by air bubbles. The lake Vico resembles a crater, and was said by the ancients to have been formed by the sinking of the ground. The lake Bolseno resembles an ancient crater, but its circumference is twenty miles, which is greater than that of any known volcano.* The lagunes of Tuscany evolve sulphureous vapours and gases, and the boracic acid is sublimed alike from the lagunes of Tuscany and from the crater of the island of Volcano.

"The lagunes in question are represented as being little cratershaped cavities formed on the surface of the ground, by the continual escape of sulphuretted hydrogen gas from fissures in the rock. These cavities, according to Prystanowski, (a German, who has published the most modern account of this phenomenon,) are at the bottom of a valley, and are therefore often filled with water, either by the rain, or by the overflowings of an adjoining brook.

"This water is raised to a boiling temperature by the passage of the heated gas through it, and hence it is that the lagunes generally emit a lofty column of steam, which first arrests the traveller's attention, and has consequently led to the adoption of the name Fumacchie, by which the lagunes are often designated.—The sulphuretted hydrogen carries up with it in a gaseous state some boracic acid, but this is condensed by the water, and is found amongst the mud, when the pool has dried up in consequence of the evaporation from it exceeding the supply from without.

"The lagunes are situated a few miles to the S. W. of Volterra, near Monte Rotundo, and near Monte Cerboli, the rock, from whence the vapor issues is calcareous."

Rome.—It was a favorite idea with Breislac, that "Rome itself occupied the site of a volcano, having been erected on the tottering edge of a crater." Professor Daubeny thinks that however well suited this idea may be "to point an antithesis, or to illustrate the vanity of human pretensions, it

* Kirauea in Owyhee, (Hawaii,) is ten miles in circumference.

rests on too slender grounds to deserve a place in a scientific treatise."

"The soil of Rome, as an eminent Italian geologist has since fully proved, is in reality composed of an alternation of sandy or calcareous beds, with a tuff containing fragments of scoriform as well as compact lava, often rolled, and accompanied likewise with pebbles of the Appenine limestone, that display evident marks of attrition. There is however no proof that these fragments of lava were ejected by any volcano which occupied the immediate site of Rome, on the contrary the nearest spot from which we can suppose them to be derived, is the Lake of Albano, more than twelve miles distant."

"The whole of the country for several miles around Albano, abounds in volcanic appearances. Amongst the mountains in this group are no less than four lakes, which appear originally to have been craters, the one already mentioned, that of Nemi, Joturna, and Vall. Aricia. With respect to the latter place, Pliny mentions a report that the ground would set fire to charcoal, and Livy notices a shower of stones that fell there, as well as the bursting out of a warm spring, having its water mixed with blood, which Heyné supposes to have been bitumen.

"Yet the differences of mineralogical character between the volcanic rocks of these mountains, and those found at Rome itself, oblige us to abandon the idea that the latter can have been derived from the same quarter. The hills in the immediae vicinity of Rome, consist of that aggregate of volcanic materials which all are agreed to designate as tuff, whilst the neighborhood of Albano is constituted of a material which the Italian geologists have chosen to mark as a separate rock under the name of Peperino. It is easy, says Von Buch, to distinguish these two substances; in peperino nearly the whole mass is fresh, undecomposed, and bright to the eye, whereas in tuff the greater part is dull, and appears weathered. The former resembles a porphyry, the latter a sandstone and other similar aggregates. The substance, of which peperino consists, preserves almost uniformly an ash-grey colour, but the tuff of Rome is generally darker. With respect to its fracture too, peperino is less friable than tuff, and the mica, which is distributed over it either in detached plates, or collected into masses, sometimes as large as a cannon-ball, mixed with crystals of augite and magnetic ironstone, preserves its original black colour and lustre, which in the tuff is not the case."

Professor Daubeny is of opinion not only that the materials constituting the immediate substratum of Rome and of its vicinity, are of volcanic origin, but that there are evidences of a still subsisting languid volcanic action.

"It would appear, that these indications, (if they may be so considered,) of languid volcanic action, were more extensively distributed about the neighborhood in earlier periods than at the present. Thus Varro makes mention of warm baths near the temple of Janus, whence the spot obtained the name of *Lautolæ* "*à Lavando*;" a spot on the Esquiline Hill was called *Puticulæ*, from the sulphureous smell which it emitted; and the wood consecrated to the Goddess Mephitis renders it probable that a noxious gas arose from that place. All these have now ceased, and nothing remains but the Lago de Solfatara to remind us of their existence.

"It is remarkable that no kind of animal is seen near this water, a circumstance which can only be attributed to the noxious qualities of the sulphuretted hydrogen, for the Lago de Tartaro near, so well known for its calcareous incrustations, contains abundance of molluscæ. Shells are also rare in the ancient travertine near Rome.

"The existence of masses of this latter substance, on the very summits of the Seven Hills proves, that at the period of its formation, the site of Rome must have been covered with water to the depth of at least one hundred and forty feet.

"From the character of the shells sometimes contained in the Travertine, which Brocchi has ascertained to belong to existing species, we may conclude that the water, which deposited it, was not impregnated with salt, and are consequently enabled to fix the date of the volcanic tuff which accompanies these Neptunian deposits, as corresponding with that of the latest fresh water formation.

"Brocchi has further shewn, that the beds above noticed all rest upon a formation containing oysters and other marine shells, which is seen underlying the rest at the Monte Mario, and in the excavations made at the foot of the Capitoline Hill."

Rome to Naples.—After passing the Pontine marshes, the traveller comes to the town of Sessa, standing on volcanic tufa, which covers the ruins of an ancient city, built like Herculaneum. A chamber with antique frescos and an ampitheatre have been discovered, by digging, and not far off, a rivulet has uncovered streams of lava. But there is neither history nor tradition of the eruption or of the volcano.

"Rocca Monfina seems to retain the vestiges of the great original crater from which these volcanic masses proceeded. In many parts indeed its sides have fallen in, but enough yet remains to enable the eye of the traveller to fill up the outline. The now detached hills, which appear to have resulted from the destruction of the walls of the crater, must have enclosed a circumference of no less than nine miles, but it is probable that the actual section is much below its former elevation, and that its height was at first considerably greater.

"Within the space occupied by the original crater, two other volcanic cones have since been thrown up, each provided with its crater; the magnitude of one of them may be judged of by the fact, that on the summit of the cone is a plain near a mile in circumference, bounded by two lofty eminences, which are the remains of it.

"It appears therefore that the latest eruptions of this volcano have taken place since the country was inhabited by man."

The Ponza Islands are composed principally of rocks of the trachytic series.

In the midst of the chain of the Appennines is mount Vultur, celebrated by Horace, as the scene of some of his early poetical adventures. It is covered with cones and craters—one of which is two thousand feet deep, and two of them are lakes. The lava of this mountain abounds with the mineral called Haüyne.

"About a mile to the east of Mount Vultur, in a place called Rendina, is a *Moffette*, or an exhalation of some noxious vapor, which produces a sharp, smarting sensation on the organs of sight, smell, and taste, and causes fainting in those who breathe it too freely. Near Atella, on the western side of Mount Vultur, are waters impregnated with sulphuretted hydrogen, and carbonic acid gases. I know not whether the neighboring town of Acherontia, now Achera, derived its name from any appearances of the same kind, like Lake Fusaro, near Naples.

"The magnitude of Mount Vultur, which is stated differently at twenty-two and at thirty miles in diameter at its base, indicates the extent of the volcanic operations that formerly must have taken place, yet all records of its eruptions are lost in the darkness of antiquity."

Between the two volcanos of Mount Vultur and Rocca Monfina, is the lago de Ansanto.

"It has a circumference of about one hundred and sixty feet; and is no more than five or six in depth; its waters are from seven to twenty-one degrees of Reaumur above the temperature of the external air, the excess being least in winter and greatest in autumn; it is in continual and violent ebullition from the rise of much sulphuretted hydrogen gas, the odour of which is very perceptible at a distance. Besides this there are given out from clefts in the rock near the lake much sulphurous acid, carburetted hydrogen, and carbonic acid gases. These being wafted to different places, according to the direction of the wind, become fatal to the animals in the lower parts of the valley, the specific gravity of the sulphureous and carbonic acid gases causing them to accumulate near the surface of the ground. As no injurious effects are caused to the *windward* of the spots from whence the vapour issues, we may readily explain the seemingly capricious action of the *mofette* upon animals in different parts of the valley, by the direction towards which the wind blows. The waters of the lake being impregnated with hepatic air are celebrated in many diseases of cattle, and provided there be the slightest movement in the atmosphere, the gases do not accumulate around its borders in sufficient quantity to be pernicious.

"There is one spot however in the midst of a torrent which flows along the valley, called the "*Vado Mortale*," from the nature of the *mofette* existing there. This, which consists entirely of carbonic acid, attains usually to the height of four or five feet, so that it is constantly fatal to the auimals that pass the stream at that point.

"A vast accumulation of sulphur takes place in this valley, owing doubtless to the decomposition of the sulphuretted hydrogen, which is emitted in such quantities that it has been proposed to collect it for commerce; and petroleum has likewise been met with intermixed with the former combustible. Volcanic products occur in the neighborhood."

Vesuvius.—To the east of the bay of Naples, rises the most recent of the volcanos in this region, and the only one that is in activity.

The present cone probably dates from the year 79 of the Christian era, when Pompeii, Herculaneum and Stabiœ were destroyed, as is believed on strong evidence, by the explosion of the ancient Somma, a vastly larger volcanic mountain, a part of the walls of whose ancient crater still remain. Vesuvius is in the centre of this ancient volcanic amphitheatre, and is supposed to be only the subsidiary cone, which was thrown up after the grand explosion of Somma. We must refer to Professor Daubeny's work, and to the ancient authors whom he quotes, for the details of the evidence which go to establish the above positions.

It is believed that within the crater of the ancient Somma, Spartacus the general of the Roman insurgents took refuge, when pursued.

"Vesuvius was the spot pitched upon for their first enterprise. Being besieged there by Clodius Glaber, they descended through the defiles of this mountain by means of vine twigs, and reached its very bottom, where they surprised by a sudden assault the camp of the general, who anticipated nothing of the kind.

"Plutarch, who evidently refers to the same event, notices it in a manner, which perhaps will enable us to ascertain what the real structure of the mountain at that time must have been. After describing the first successes of Spartacus and his army, he says: "Clodius the Prætor was sent against them with a party of three thousand men, who besieged them in a mountain (meaning evidently Vesuvius) having but one narrow and difficult passage, which Clodius kept guarded; all the rest was encompassed with broken and slippery precipices, but upon the top grew a great many wild vines; they cut down as many of these boughs as they had need of, and twisted them into ladders, long enough to reach from thence to the bottom, by which, without any danger, all got down except one, who stayed behind to throw them their arms, after which he saved himself with the rest."

The direction of the strata of Monte Somma, is such as corresponds with the supposition that it was anciently a crater, and notwithstanding some difficulties as to the dykes of this mountain, the passage is instructive as to the formation of volcanic mountains; we shall quote it.

"Every mountain of this description, he maintains, has been originally produced by a series of operations succeeding each other in the following order. When once the violence of the volcanic operations has arrived to such a pitch as to create a rupture of the strata of the earth, the elastic vapours, hitherto pent up, throw out portions of the liquid lava, through which they force their way, just as takes place when a mass of melted metal happens to fall into a vessel containing water. These portions, projected into the air, descend again either in the form of scoriæ or sand, and collect into an aggregate, which when agglutinated together will form tuff. But the projection of these fragments is soon followed by the overflow of the melted lava itself, which by degrees reaches the brim, spreads over the tuff, and forms a regular bed encircling the original aperture. The repetition of these successive operations causes that alternation of beds of lava and tuff which compose the substance of most volcanic mountains, and it will be at once perceived, that the direction in which they are found to lie, rising on all sides towards the crater, is a necessary result of this mode of formation."

In the notice of Mr. Scrope's work on volcanos, in our last number, allusion was made to the cultivated state of Vesuvius, immediately before the catastrophe of Herculaneum and Pompeii. Ætna was active and familiarly known by its eruptions, but Vesuvius was as truly, to appearance, an extinct volcano, as the cones of Auvergne are now. Its crater was covered by vegetation, and its slopes by vineyards, fields, and villas. History gave no distinct account of its eruptions, and even tradition had transmitted only an indistinct suspicion of its real character. Diodorus Siculus, Vitruvius, and Strabo, were impressed with the appearances of igneous action around Vesuvius, and the philosophers of those days, although unaided by accurate science, reasoned as to Vesuvius as we reason now, with regard to the extinct volcanos of France and Germany.

"This period of apparent security was however at length to cease; in the year 63 after Christ, the volcano gave the first sympton of internal agitation in an earthquake, which occasioned considerable damage to many of the cities in its vicinity. A curious proof of this is exhibited by the excavations made at Pompeii, which shew that the inhabitants were in the very act of rebuilding the houses overturned by the preceding catastrophe, when their city was finally overwhelmed in the manner I am about to describe.

"On the 24th of August of the year 79, the tremendous eruption took place, which has been so well described in the letters of the younger Pliny. It was preceded by an earthquake which had continued for several days, but being slight was disregarded by the inhabitants, who were not unaccustomed to such phenomena. However on the night preceding the eruption the agitation of the earth was so tremendous, as to threaten every thing with destruction.

"At length about one in the afternoon, a dense cloud was seen in the direction of Vesuvius, which after rising from the mountain to a certain distance in one narrow vertical trunk, spread itself out laterally in a conical form, in such a manner, that its upper part might be compared to the branches, and the lower to the trunk of a pine. It was descried from Misenum, where the elder Pliny, as commander of the Roman fleet, was stationed, with his family, among whom was his nephew the younger Pliny. The latter, who seems already to have imbibed somewhat of the spirit of the Stoical philosophy, which inculcated rather an in-difference to the course of external events, than an inquiry into their nature, pursued his usual train of studies as before; but the former, with the zeal and enterprize of a modern naturalist, prepared in defiance of danger, to obtain a nearer view of the phenomena.

"Accordingly he first repaired to Resina, a village immediately at the foot of Vesuvius, but was soon driven back by the increasing shower of ashes, and compelled to put in at Stabiæ, where he proposed to pass the night. Even here the accumulation of volcanic matter round the house he occupied, rendered it necessary for him to remain in the open air, where it would appear that he was suddenly overpowered by some noxious effluvia, for it is said that whilst sitting on the sea-shore under the protection of an awning, flames, preceded by a sulphureous smell, scattered his attendants, and forced him to rise supported by two slaves, but that he quickly fell down, choaked, as his nephew conjectured, by the vapor, which proved the more speedily fatal from his previous weak state of health. The absence of any external injury proves, that his death was caused by some subtle effluvia, rather than by the stones that were falling at the time, and it is well known that gaseous exhalations, alike destructive to animal and vegetable life, are frequent concomitants of a volcanic eruption.

"The other circumstances of this memorable catastrophe are sketched by the younger Pliny with a rapid but masterly hand. The dense cloud, which hovered round the mountain, pierced occasionally by flashes of fire more considerable than those of lightning, and overspreading the whole neighborhood of Naples with darkness more profound than that of the deepest night; the volumes of ashes which encumbered the earth, even at a distance so great as that of Misenum; the constant heaving of the ground, and the recession of the sea, form together a picture, which might prepare us for some tremendous catastrophe in the immediate neighborhood of the volcano.

"Yet the covering of three entire cities under an heap of ashes from sixty to one hundred and twelve feet in depth, would seem an effort almost too gigantic for the powers of this single mountain, if we were not aware of the vast depth at which the volcanic operations are going on, and the immense extent to which their influence may therefore be supposed to reach. It has been calculated indeed that the masses ejected at different times from Vesuvius vastly exceed the whole bulk of the mountain;* and yet the latter seems upon the whole to undergo no dimunition,

* This was remarked even by the ancients, and Seneca, Letter 79, after starting the difficulty, solves it by remarking, that the fire of the volcano, "in ipso monte non alimentum habet, sed viam."

for the falling in of its cone at one period appears to be balanced by the accumulation of ashes at another.

"The cities of Stabiæ, Pompeii, and Herculaneum, which were destroyed in the course of this eruption, appear to have been overwhelmed, not by a stream of melted matter, but by a shower of cinders and loose fragments; * for the various utensils and works of art that have been dug from thence nowhere exhibit any signs of fire, and even the delicate texture of the Papyri appears to have been affected only in proportion as it has subsequently been exposed to air and moisture. Thus in those at Pompeii, which was covered by a mere uncemented congeries of sand and stones, decomposition has proceeded so far that their contents are illegible, whereas at Herculaneum, where they have been preserved under a species of tuff, their characters often admit of being decyphered. Now the formation of this latter substance is explained on the supposition of a torrent of mud having accompanied in this quarter the ejections of the volcano, which favoring the agglutination of the loose materials, reduced them to a state, which though less consistent than tuff generally is, was capable of preventing in some degree the access of air and humidity to the substances underneath. Sir W. Hamilton notices a fact, which shews very conclusively both that the tuff of Herculaneum was once in a pasty state, and that it owed its softness not to heat but to moisture, the head of a statue that was dug up, having left a cast in the tuff which had formed upon it, without appearing to be itself in the least scorched."

In the notice of Mr. Scrope's work the principal recorded eruptions of Vesuvius have been already mentioned, and it is not necessary to repeat the statement. During the late century the volcano was very active—there being eighteen eruptions in the course of one hundred years.

"That of 1737, gave rise to a stream of lava, which passed through the town of Torre del Greco, and continued its course until arrested by the sea, at which time its solid contents were estimated at thirty three millions five hundred and eighty seven thousand fifty eight cubic feet."

In the formidable eruption of 1794, the town of Torre del Greco was again destroyed, and the current of lava advanced into the sea three hundred and sixty two feet, with a front of one thousand one hundred and twenty seven feet.

The cubic contents of this current were estimated by Bries-

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* The stones that fell at Pompeii are said many of them to weigh eight pound, the largest of Stabiæ only an ounce.

lak at forty six millions ninety eight thousand seven hundred and sixty six cubic feet. It is remarkable that among the ejections of Vesuvius, including chiefly those of the ancient mountain, more than one third of the minerals of the globe are included.

The gaseous exhalations from Vesuvius are principally sulphureous and muriatic acid gases and some nitrogen and much aqueous vapor: the latter is often the sole emission from the fumaroles that surround the crater, when the mountain is quiet. Fatal exhalations or moffettes are given out from the crevices of the mountain; they run into the neighboring cellars and destroy the vegetation in the fields; they are supposed to be chiefly carbonic acid gas.

We omit the mention of the facts connected with the discussion respecting the reputed change in the elevation of the temple at Puzzuoli, although it is evident from the hot springs which now gush out from its side, as they did one thousand six hundred years ago, that no very great change can have happened.

Much more decisive evidence of change is presented by the Monte Nuovo whose rise on the northern side of the bay of Baiœ, is thus described by our author.

Monte Nuovo.

"Vesuvius had at that time been for a long interval tranquil, but a succession of earthquakes had taken place in the country for two years previously. At length on the 28th of September, of the year 1538, flames broke from the ground between Lake Avernus, Mount Barbaro, and the Solfatara, followed by several rents of the earth from which water sprung, whilst the sea receded two hundred feet from the shore, leaving it quite dry. At last, on the 29th, about two hours after sun-set, there opened near the sea a gulph, from which smoke, flames, pumice and other stones, and mud were thrown up, with the noise of thunder.

"In about two days the ejected masses, formed a mountain 413 feet in perpendicular height, and 8000 feet in circumference. The eruption finally ceased on the 3d of October. On this day the mountain was accessible, and those who ascended it reported, that they found a funnel-shaped opening on the summit—a crater, a quarter of a mile in circumference."

"The Monte Nuovo is composed entirely of fragments of scoriform matter, or of a compact rock of an ash grey color, sometimes resembling trachyte, and at others approaching to porphyry slate. The scoriform matters include pumice, and most other varieties of volcanic substances, intermixed with a white sand, but never agglutinated so as to form a tuff. Its form is that of a compressed or oblong cone, and it has in its centre a crater almost as deep as the mountain is lofty.

"Near the bottom of the crater are one or two small caverns, the interior of which I found covered here and there with an efflorescence, having an alkaline taste. The sand near the foot of the mountain, even under the sea, possesses so high a temperature when brought up from a little below the surface of the water, that we are led to conclude that the volcanic action is still going on to a certain extent, and the same inference may be drawn from the extreme heat of the water which gushes from the rock in a cavern not far distant, called the Baths of Nero, which is sufficient in a very few minutes to boil an egg."

Solfatara.—The celebrated hill of Solfatara is an extinct or dormant volcano; the rock is a variety of trachyte, the ground returns a hollow sound when struck, indicating a cavernous basis, the gases collected are a little muriatic acid and much sulphuretted hydrogen from the decomposition of which, as the author ingeniously reasons, the abundant sulphur of this place arises, and not from sublimation of free sulphur. The Puzzolana so much celebrated in other countries as an ingredient in hydraulic mortar "is a formation of volcanic tuff, bearing many analogies to the trass of the Rhine and the pumiceous conglomerates of Hungary."

"The height of this tuff, in many places near Naples, is very considerable; the hill of the Camalduli, the loftiest eminence next to Vesuvius in the whole country, is composed of it, and to the west of Naples it forms a sort of wall, so lofty and abrupt, that the former inhabitants of the country apparently found it easier to avail themselves of the soft and friable nature of the stone, and to cut through, than to make a road over it.

"This is the origin of the celebrated Grotto of Posilippo, a cavern three hundred and sixty-three toises, or two thousand one hundred and seventy-eight feet in length, fifty feet in height, and eighteen in breadth, which strikes every stranger with surprise from the mass of rock cut through, until he reflects at the ease with which a stone of such a description admits of being hollowed out.

"This immense mass of Puzzolana forms some considerable hills round Naples, many of which, as the Monte Barbara, Astroni, and others, have very regular craters, but do not appear to have thrown out any currents of lava."

The Grotto del Cane or Dog's grotto is mentioned by every traveller; it is in the same situation as in the days of Pliny. It is on the borders of the lake Aquano, an ancient crater; it has a stratum of carbonic acid gas on the floor which flows over the lip of the cavern like water, and suffocates a dog whose nose is immersed in this deadly atmosphere, while a man walks in security. Phosphorus would burn at two feet from the floor but the heat of the steel spark was not sufficient to explode gunpowder in a pistol pan.

The Lake of Avernus is supposed to have been the crater of a volcano; birds now resort to it with impunity.

The Monte Barbara, the most lofty ancient extinct volcano near Naples, has a solitary farm house in its now verdant crater, and the crater of Astroni, nearly a mile in diameter, is so perfect an inclosure that the king of Naples uses it "as a *preserve* for his wild boar and other animals destined for the chase. Its walls are a congeries of scoriæ, pumice and other ejected materials."

The region around Naples and Vesuvius still retains its ancient name—*The Phlegrean Fields*, and the appearances which it now presents, justify the belief that it was anciently a region of extensive and furious volcanic action.

"Even if we limit the craters that existed in the Phlegrean fields to those of which present appearances leave no doubt, their number will be sufficient to give us a frightful picture of the condition of the country at an early period of history, and serve to account for the fables of the Poets, who imagined the entrance to the Infernal Shades to lie among these recesses.

"It was not then, as at present, a single mountain which sent forth flames and melted matters at certain intervals, and secured a comparative immunity to the rest of the district; but there was a constant exhalation of noxious vapours from a variety of orifices, attended with earthquakes, and other phenomena, which bespeak the operation of volcanic agency over a widely extended surface.

"If then the early settlers in Sicily were so alarmed at the eruptions of Mount Etna, as to fly to some other part of the island, and if in modern times, among the Canaries, the inhabitants of Lanzerote were compelled to migrate on account of the ravages made upon their possessions during a succession of years by subterranean fire, it is not unnatural that the picture which Homer had received of the Phlegrean fields should have been so terrific, as to have led him to describe them as placed at the utmost limits of the habitable world, unenlightened either by the rising or setting sun, and with groves consecrated to Proserpine, rivers with streams of fire, and enveloped in an eternal gloom. These ideas would be confirmed, if we imagine that the Cimmerians, who first peopled the country, lived in those caverns and hollows of the rock which now exist, and were thus by the very nature of their habitation shut out from the light of day.

"Such a picture indeed accords very little with the ideas suggested by the luxuriance of modern Campania; but it must be recollected, that at the time when Homer wrote, that luxuriance had not yet been developed by cultivation, that the recent occurrence of the eruptions had probably devoted many parts to a temporary sterility, and that others were overshadowed with thick and gloomy forests."

Procida and Ischia, islands contiguous to this coast are composed of volcanic materials; but the only immediate proof of volcanic action is the temperature of 110° of Fahrenheit, which is found in the sand, two feet below the surface at Monte Vico, and the hot vapor which in many places in that neighborhood issues from the ground.

The fiorite or hyalite appears to arise from the action of the steam upon the fissures through which it passes, and similar facts have been observed at the Solfatara at Santa Fiora in Tuscany, at Teneriffe and Lanzerote and at the Geysers.

The Lipari Islands, lying between Naples and Sicily, form both a geographical and a geological connexion between the volcanic systems of the two countries.

Stromboli has already been mentioned as a volcano which is incessantly active. The crater is on the side of the hill and rising at a great angle immediately on the margin of the sea, most of the ejections tumble into the water.

"I reached with considerable difficulty the summit of the mountain, which, rises at an angle often of nearly 40°, and is covered completely with volcanic sand, consisting of titaniferous iron, amongst which I found numerous crystals of augite, and masses of black pumice, or of an highly scoriform and fibrous description of lava, which seems to approach nearly to that mineral.

"On looking down from that elevation upon the volcano, I perceived that its minor explosions were in general almost continuous, but that the greater ones, which alone were audible below, take place at intervals of about *seven minutes.* The latter were sufficiently terrific to give me an idea of what takes place during an eruption of Etna or Vesuvius, but as the wind did not blow the stones in our direction, we should have incurred no considerable risk in approaching it nearer. On expressing however this wish to my guides, I was reminded, by their refusing to accompany me, of the remark which Spallanzani makes in respect to the superstitious horror entertained in his time by the Liparotes of the crater of Volcano, which obliged him to procure a Calabrian for his attendant; and finding that no one would venture to accompany me nearer, I thought it prudent to abandon the attempt."

Pumice so well known in the arts, abounds in the Lipari islands, whence most of that used in Europe and America is obtained, and obsidian is considerably abundant, although it is difficult to say what circumstances determine volcanos to produce these forms of ignigenous materials rather than others. Dr. Daubeny thinks that

"For the formation of pumice it seems requisite that a considerable disengagement of vapor should have taken place, during the time at which the body acted upon was in a plastic, though not in an altogether fluid condition."

The vitreous lavas of Lipari, (obsidian,) are not always loosely ejected, suddenly cooled masses, but they constitute "extensive beds, which ought, it would seem to have been subjected to the same laws of congelation as the lavas of other volcanos."

The only indications of active volcanic agency now existing in the island of Lipari, are the hot springs, about four miles west of the town, but ancient authors speak of volcanic eruptions and earthquakes as so common in these islands that probably the inhabitants had acquired that degree of familiarity with them which is ascribed by Humboldt to the inhabitants of Peru:—

"On the coast of Peru, earthquakes are so frequent, that we become as much accustomed to the undulations of the ground, as the sailor is to the tossings of the ship, caused by the motion of the waves.

"From our infancy, the idea of certain contrasts fixes itself in our minds; water appears to us an element that moves; earth, a motionless and inert mass. These ideas are the effect of daily experience; they are connected with every thing that is transmitted to us by the senses. When a shock is felt, when the earth is shaken on its old foundations, which we had deemed so stable, one instant is sufficient to destroy long illusions. It is like awakening from a dream; but a painful awakening. We feel, that we have been deceived by the apparent calm of nature; we become attentive to the least noise, we mistrust for the first time a soil, on which we had so long placed our feet with confidence. If the shocks be repeated, if they become frequent during successive days, the uncertainty quickly disappears. In 1784 the inhabitants of Mexico were accustomed to hear the thunder roll beneath their feet, as we are to witness it in the region of the clouds."

The Island of Vulcano is separated from Lipari by a narrow channel. It affords one peculiar product that is "boracic acid, which lines the sides of the cavities with beautiful white silky crystals."

"The operations of this volcano appear to be going on with much greater vigor than those of the Solfatara, and exhibit perhaps the nearest approximation to a state of activity, during which a descent into the crater would have been practicable.

"Nor can I imagine a spectacle of more solemn grandeur than that presented in its interior, or conceive a spot better calculated to excite in a superstitious age that religious awe which caused the island to be considered sacred to Vulcan, and the various caverns below as the peculiar residence of the God.

> "Quam subter, specus, et Cyclopum exesa caminis
> Antra Etnea tonant, validique incudibus ictus
> Auditi referunt gemitum, striduntque cavernis
> Stricturæ Chalybum, et fornacibus ignis anhelat,
> Vulcani domus et Vulcania nomine tellus."

"To me, I confess, the united effect of the silence and solitude of the spot, the depth of the internal cavity, its precipitous and overhanging sides, and the dense sulphureous smoke, which, issuing from all the crevices, throws a gloom over every object, proved more impressive than the view of the reiterated explosions of Stromboli, contemplated from a distance, and in open day."

Sicily.

The account of the geology of Sicily contained in Dr. Daubeny's memoir on that country, already alluded to, (see Vol. 10, p. 230 of this journal,) will induce us to confine our relations principally but not exclusively to the facts connected with Ætna.

The central portion of Italy is occupied by a vast deposit of blue clay or marl containing numerous and thick beds of gypsum, with sulphur and the sulphurets of iron and copper.

"The crystals of sulphat of strontian, found in the sulphur mines are unrivalled for their beauty; and are mixed with those of sulphur, lining the fissures, often in large and regular octahedra."

The celebrated mud eruptions especially at Macaluba, which sometimes throw mud, bitumen and gases, mixed, to the height of two hundred feet are attributed by Professor Daubeny to the slow combustion of beds of sulphur. But we dismiss subordinate considerations that we may bestow the greater attention on Ætna.

Ætna.

"This mighty and imposing mountain, which rises in solitary grandeur to the height of above ten thousand feet, and embraces a circumference of one hundred and eighty miles, is entirely composed of lavas, which, whatever subordinate differences may exist between them, all possess the appearance of having been ejected above the surface of water, and not under pressure.

"In the structure of this mountain, every thing wears alike the character of vastness. The products of the eruptions of Vesuvius may be said almost to sink into insignificance, when compared with these coulées, some of which are four or five miles in breadth, fifteen in length, and from fifty to one hundred feet in thickness, and the changes made on the coast by them are so considerable, that the natural boundaries between the sea and land seem almost to depend upon the movements of the volcano.

"The height too of Etna is so great, that the lava frequently finds less resistance in piercing the flanks of the mountain, than in rising to its summit, and has in this manner formed a number of minor cones, many of which possess their respective craters, and have given rise to considerable streams of lava.

"Hence an antient poet has very happily termed this volcano the parent of Sicilian mountains, an expression strictly applicable to the relation which it bears to the hills in its immediate neighborhood, all of which have been formed by successive ejections of matter from its interior.

"The grandest and most original feature indeed in the physiognomy of Etna, is the zone of subordinate volcanic hills with which it is encompassed, and which look like a court of subaltern princes waiting upon their sovereign.

"Of these, some are covered with vegetation, others are bare and arid, their relative antiquity being probably denoted by the progress vegetation has made upon their surface, and the extraordinary difference that exists in this respect seems to indicate, that the mountain, to which they owe their origin, must have been in a state of activity, if not at a period antecedent to the commencement of the present order of things, at least at a distance of time exceedingly remote."

"The silence of Homer on the subject of the eruptions of Etna is indeed often quoted in proof of the more modern date of this volcano; but to such *negative* evidence we have to oppose the *positive* statement of Diodorus Siculus, who notices an eruption long anterior to the age of this poet, as he says that the Sicani, who with the exception of the fabulous Cyclops and Lestrigons, were the first inhabitants of the island, and who are admitted on all sides to have possessed it considerably before the Trojan war, deserted the neighborhood of Mount Etna in consequence of the terror caused by the eruptions of the volcano.

"This is confirmed by Dionysius Halicarnassus, who states that the Siculi, who passed over from Magna Græcia about eighty years before the Trojan war, first took possession of that part of the island which had been deserted by the Sicanians, so that it is probable that the mountain was at that period tolerably tranquil, and supposing no eruption to have taken place from that time till the age of Homer, it is by no means unlikely, that in a barbarous age, the tradition of events so remote may have been in great measure effaced, and thus have never reached the ears of the Greek poet.

"The earliest historian by whom the volcano has been noticed is Thucydides, who says, that up to the date of the Peloponnesian war, which commenced in the year 431 B. C. three eruptions had taken place from Mount Etna, since Sicily was peopled by the Greeks. It is probably to one of these that Pindar has alluded in his first Pythian Ode, written according to Heyné in consequence of the victory obtained by Hiero in the year 470 B. C. It may be remarked that this poet particularly speaks of the streams of lava which if we may judge from Vesuvius, are less usual concomitants of the first eruptions of a volcano.

"Diodorus Siculus mentions an eruption subsequent to the above, namely in the 96th Olymp. or 396 years B. C. which stopped the Carthaginian army in their march against Syracuse. The stream may be seen on the eastern slope of the mountain near Giarre, extending over a breadth of more than two miles, and having a length of twenty-four from the summit of the mountain to its final termination in the sea. The spot in question is called the Bosco di Aci; it contains many large trees, and has a partial coating of vegetable mould, and it is seen that this torrent covered lavas of an older date which existed on the spot.

"Four eruptions are recorded to have happened between this period and the century immediately preceeding the Christian era, during which latter epoch the mountain seems to have been in a state of frequent agitation, so that it is noticed by the poets among the signs of the anger of the gods at the death of Cæsar.

"After this for about a thousand years its eruptions are but little noticed, but during the last eight centuries they have succeeded each other with considerable rapidity. Referring however to the chronological list of the eruptions of the mountain for a specification of these, I shall here merely allude to such as have produced some remarkable change in the character of the country."

"In the memorable eruption of 1669, a rent twelve inches in length took place on the flank of the mountain above Nicolise, about half way between Catania and the summit; and from this fissure descended a torrent of melted matter, which continued flowing for several miles, destroyed a part of Catania, and at length entering the sea, formed a little promontory, which serves to arrest the fury of the waves in that quarter; at the same time the accumulation of matters ejected, raised on the mountain two conical hills called the Monti Mossi, which measure at their base, about two Italian miles, and are in height more than three hundred feet above the slope of the mountain, on which they are placed," Ferrara.

Professor Daubeny has given a table shewing the correspondence in point of time between the eruptions of Ætna, Vesuvius and the other volcanos connected with them.

The earliest eruption of Etna that is recorded, was about 480 years before Christ, and there were nine others before that epoch, besides one of the Eolian Isles and one of Ischia. Vesuvius had no eruption during this period nor is any previous one known although it is certain that there must have been eruptions more ancient than any that are recorded of Etna and the same remark may be made of Etna itself.

From the birth of Christ to 1824, there were only six eruptions of Etna; in the mean time there were nine of Vesuvius.

In 1198, the Solfaterra was inflamed, and in 1302 there was an eruption of Mount Epemeo in Ischia. From 1329 to 1719 there were forty-two eruptions of Etna, not quite one to a century. Vesuvius gave in the same time, or rather from 1306 to 1822, forty-two eruptions; the ratio of time a little more.

"It appears from this table that the nearest coincidence between the eruption of the two volcanos was in 1694 and in 1811, when they occurred within a month of each other; and that on eight several occasions an interval of less than half a year elapsed between them, viz. that of Vesuvius December 2, 1754, was followed by one of Etna on March 2, 1755; Vesuvius August 3, 1779, by Etna May 18, 1780; Vesuvius October 31, by Etna July 28, 1787; Etna June, 1788, by Vesuvius February, 1799; again followed by one of Etna in June, same year; Etna March 27, 1809, by Vesuvius December 10, 1809; Vesuvius October 12, 1811, by Etna October 25, 1811; again followed by Vesuvius December 31, same year; Vesuvius May 27, 1819, by Etna, November 25, same year."

The analysis already given, embraces all the countries in which Professor Daubeny made personal observations and includes about half his volume. In the remainder we have a notice of volcanos existing in countries not visited by the author; and general remarks on volcanic phenomena.

As it is our object not merely to display the uncommon merit of Dr. Daubeny's performance, but by its aid to bring under the eyes of our readers, a succinct and yet comprehensive account of volcanic formations both ancient and modern; and of the most important phenomena connected with them, we will proceed upon the plan already presented.

Iceland.

Sir G. Makenzie, in his work on Iceland "notices two varieties of volcanic products in this island, one of which appeared to him of submarine, the other of terrestrial origin.

"Among the rocks referred to the former period, the prevailing substance was a tuff containing fragments of cellular lava, of pearlstone, and of amygdaloid, the cavities of which were filled with calcareous spar. With this tuff alternate beds of scoriform lava, and both are traversed by dykes of greenstone, perfectly compact, and without any vitreous aspect, thus serving to shew the manner in which the characters of a rock depend upon the degree of pressure exerted during its formation. In the case of the bed the structure is cellular, because it probably flowed freely over the surface, without being subjected to any pressure considerable enough to counterpoise the expansive force of the elastic vapours disengaged; in the case of the greenstone dykes, the rock itself, through which they forced their way, may have opposed a resistance sufficiently considerable to have prevented the formation of cells."

"The cellular aspect of the constituents of these submarine lavas seems to shew that their age is, comparatively speaking, modern, and with this the almost total absence of any Neptunian products completely accords.

"Sir G. Makenzie has noticed an effect of volcanic action of a kind rather different from that which has hitherto come before us.

"In many places, he says, an extensive stratum of volcanic matter has been heaved up into large bubbles or blisters, varying from a few feet to forty or fifty in diameter. It also contains numerous little craters, from which flames and scoriæ had issued, but no lava. These craters are often partially covered in by domes of the same materials, as though the whole rock had been first softened by the operation of heat; and portions of it had then been made to swell outwards by the extrication of elastic vapours.

"Our author has chosen to distinguish this variety by the name of cavernous lava; its date is probably anterior to that of the commencement of the present order of things, for it is in many cases covered with gravel, and seems to extend under the sea.

"When I come to speak of the Island of Lanzerote, I shall have occasion to point out appearances described by Von Buch, of a very analogous kind; and shall therefore defer any attempt to explain them for the present, proceeding in the mean time to some other phenomena connected with the same subject, which Iceland presents to our contemplation."

The sulphur mountains of Krisiavik, consist of alternating beds of white clay and sulphur, from all parts of which steam is given out.

"This was remarkably the case in a deep hollow into which the author descended, where a confused noise was heard of boiling and splashing, joined to the roaring of steam escaping from narrow crevices. At the bottom of this hollow was a cauldron of boiling mud about fifteen feet in diameter. There was a constant sublimation of sulphur, which formed beautiful crystals round the sides of the cavity.

"The celebrated springs of Geyser are, however, the phenomena which most forcibly arrest the attention of the traveller in this country. The intermitting character of these fountains may be, in some measure, imitated by pouring a stream of water through a bent tube depressed about the centre, and heated in that part alone.

"Under these circumstances the steam suddenly generated at bottom will force one portion of the water out in a jet from the opposite extremity to that at which it entered, driving back at the same time the current of water that continued to flow in. In this manner the water might be propelled in jerks, as happens in the case of the Geyser springs.

"Such an explanation however is far from being adequate to account for the complicated phenomena of these fountains, which, after a pause of many hours, first threw up water, and afterwards vast columns of steam, to the height sometimes of two hundred feet, and then immediately sunk into a temporary repose; neither is it applicable to the singular circumstance mentioned by Mr. Henderson, as to the possibility of bringing on the explosion at any given time by merely throwing large stones into the orifice. The latter fact indeed seems to prove that the generation of steam is constant, and that nature has provided other *vents* sufficient to carry off a certain portion of the elastic vapour, unless when obstructed in the manner produced by Mr. Henderson, in which case its rapid accumulation gives rise to an almost immediate explosion."

The celebrated surturbrand of Iceland is spoken of as being almost the only substance in that country not connected with volcanic operations, for almost the whole island is the work of volcanic fire.

"The west side of a perpendicular cleft in the side of a mountain called Hagafiall exposes a section of ten or twelve horizontal strata, of which the surturbrand is undermost, occupying four layers, which are separated from each other by intermediate beds of soft sandstone and clay.

"They vary in thickness from a foot and a half to three feet, and differ also in quality, the two lowest strata exhibiting the most perfect specimens of mineralized wood, free from all foreign admixture and of a jet black, the numerous knots, roots, &c. leaving no doubt of its vegetable origin. The two upper strata contain an admixture of earthy and ferruginous matters, and in the midst of them occurs a thin layer, four inches in thickness, consisting of a schistose mass which appears to be made up entirely of leaves closely pressed together, separated only by a little clay. These leaves are chiefly of poplar, a tree, Mr. Henderson says, at present not met with on the island. The beds of surturbrand support an alternation of basalt, tuff, and lava, which extend to the summit of the hill.

"With the sole exception perhaps of this substance, the whole of the mineral structure of Iceland may be said to have originated more or less directly from volcanos, and there is probably no part of the globe in which operations of this kind have been going on with so much activity, and for so considerable a period.

The existence of submarine lavas proves the action to have commenced before the retreat of the ocean, notwithstanding which eruptions occur here more frequently at present than they do at Vesuvius or in any other known case.

"Besides Hecla, which has been twenty-two times in a state of activity during the last eight hundred years, five other volcanos are enumerated, from which the total number of recorded eruptions during the same period is no less than twenty. Some of these happened at the same time at which the volcanos of the Mediterranean were in action, but the instances of this coincidence are not sufficiently numerous to lead to any certain conclusion.

"In the year 1783 a submarine eruption took place six or eight miles from Reykiavess, which gave birth to a new island a mile in circumference, which however the following year again disappeared. A submarine eruption also took place about the same time seventy miles from the same cape, which is said to have thrown up pumice sufficient to cover the sea for a space of one hundred and fifty miles round."

Greenland.

In the island of Mayen, off the coast of Greenland, there is a volcano whose crater is five hundred feet deep, and two thousand in diameter. In 1807, Captain Scoresby saw marks of a recent eruption; cellular lava, tufa, scoriæ, &c.

Grecian Archipelago.

Our limits will not permit us to follow Professor Daubeny through the historical research connected with the volcanic history of the Grecian Archipelago, and we must be in general satisfied with conclusions only.

The island *Santorino* or *Thera*, and the smaller neighboring one Therasia are stated by Pliny, to have been thrown up by the sea, and they are composed almost entirely of volcanic substances. There is also, Canimeni or Micronesi, thrown up in 1573; and new or black island in 1707. The following facts are too interesting to admit of abridgment, and therefore we quote them entire.

"Thevenot mentions a great eruption of pumice as having taken place in the sea near Santorino in 1638, and Father Goree in 1707 was eye witness of the appearance of a new rock between little and great Cammeni, which increased in size so rapidly, that in less than a month it became half a mile in circumference, and had risen twenty or thirty feet above the level of the waters.

" The following is an extract from the account he has transmitted to us of the circumstances attending this event.

" On the 23d of May 1707, the commencement of a new island between great and little Cammeni, was perceived from Scaro, and from all that side of Santorino. It was at first taken for the wreck of a ship, but those who visited the spot under that impression, found that it was a mass of rocks, which rose from the bottom of the water. Some, whose curiosity got the better of their fear, had the hardihood to land upon it, and found the surface covered with a white and very soft stone; but, what was very remarkable, a large quantity of fresh oysters, which are rarely seen about Santorino, were found adhering to the rock newly thrown up. Whilst in the act of collecting them, they were frightened away by feeling the ground shake violently.

" Between this and the month of July the island was observed to grow gradually larger, for though many of the rocks which were added to it sunk again into the waters, a sufficient number remained to add considerably to its volume.

" In July the appearances were more awful, as all at once there arose, at a distance of about sixty paces from the island already thrown up, a chain of black and calcined rocks, soon followed by a torrent of black smoke, which from the odour that it spread around, from its effect on the natives in producing headache and vomiting, and from its blackening silver and copper vessels, seems to have consisted of sulphuretted hydrogen.

" Some days afterwards the neighboring waters grew hot, and many dead fish were thrown upon the shore. A frightful subterranean noise was at the same time heard, long streams of fire rose from the ground, and stones continued to be thrown out, until the rocks became joined to the White Island originally existing.

" Showers of ashes and pumice extended over the sea, even to the coasts of Asia Minor and the Dardanelles, and destroyed all the productions of the earth in Santorino.

" These, and similar frightful appearances continued round the island for nearly a year, after which nothing remained of them but a dense smoke.

" On the 15th July, 1708, the same observer had the courage to attempt visiting the island, but when his boat approached within five hundred paces of it, the boiling heat of the water deterred him from proceeding. He made another trial, but was driven back by a cloud of smoke and cinders that proceeded from the principal crater. This was followed by ejections of red-hot stones, from which he very narrowly escaped. The mariners remarked that the heat of the water had carried away all the pitch from their vessel.

"During the ten subsequent years, the volcanic action had given rise to several other eruptions, but the same reporter states, that in 1712 all was quiet, and no other indication of the kind existed, excepting a quantity of sulphur and bitumen, which floated on, without mixing with the waters. Its circumference at that time was about four miles.

"It is important, with reference to the natural history of volcanos, to remark that in this case, as in many others, the mountain appears to have been elevated, before the crater existed, or gaseous matters were given out. According to Bourguignon smoke was not observed till twenty-six days after the appearance of the raised rocks."

Milo appears also to be volcanic; it abounds in hot springs, sulphureous and chalybeate: sulphur is sublimed in the crevices of the rock, and alum is abundant as it was in the time of Pliny. Here, as well as in the Phlegræan fields, the noxious miasmata so abound, that the few inhabitants of this once populous island, are the very pictures of wretchedness and disease; perhaps, however, attributable in part to other causes. The theatre, which was covered with a shower of volcanic ashes, has been in part uncovered, and the steps were found to be of the marble of the island, fresh and uninjured. It is probable that Argentine, the ancient Cimoli; Cerigo, the ancient Cythera; Lemnos, and other islands are more or less of volcanic origin.

Continent of Greece.

Whether the burning mountain of Megalopolis, mentioned by Pliny, and the mud eruptions of the Lelantic fields, are connected with volcanic action, cannot be determined.

"The neighborhood of Trœzene in Argolis, would appear from Ovid to have been the seat of a volcanic eruption, which created an entire mountain, just in the same manner as in the last century the mountain of Jorullo was elevated in the midst of the table land of Mexico.

"The description of Ovid is so applicable to both these events, that I have introduced an extract from it in the frontispiece of this work, which represents the mountain Jorullo as described by Humbolt.

The following is the entire passage:—

> "Est prope Pithæam tumulus Trœzena, sine ullis
> Arduus arboribus, quondam planissima campi
> Area, nunc tumulus; nam (res horrenda relatu)
> Vis fera ventorum, cæcis inclusa cavernis,
> Exspirare aliqua cupiens, luctataque frustra
> Liberiore frui coelo, cum carcere rima
> Nulla foret toto, nec pervia flatibus esset,
> Extentam tumefecit humum; ceu spiritus oris
> Tendere vesicam solet, aut direpta bicornis
> Terga capri. Tumor ille loci permansit; et alti
> Collis habet speciem, longoque induruit ævo."
>
> METAMORPH. 1. 15.

"It is probable that Strabo may refer to the same event, where he speaks of a tract of land seven stadia high, being elevated round about Methone, owing to some exhalation of an igneous nature, for these two places are so near to each other, that they might very readily be confounded."

It seems to be agreed, that the promontory of Methone is volcanic.

"It would appear from Strabo, that even in his time the rage of the volcano was not exhausted, for he says that the mountain was sometimes inaccessible from the intensity of the heat which it occasioned, and the sulphureous odour which it diffused.

"He adds, that it was visible at night from afar, and that the sea was hot for five stadia round.

"Chandler, who visited the spot, merely mentions as still existing, the hot springs about three miles and three quarters from Methone, which first appeared after the eruption in the reign of Antigonus. The springs are on the side of the mountain near a village, and tinge the soil near them with the color of ochre."

The Bosphorus, as it would seem from the notices published by Dr. Clark, Andreossi and others, consists in part, at least, of volcanic materials, and that there is probably a true volcano, in the little island of Taman, which connects the chain of mountains traversing the Crimea, with the Asiatic continent.

Sardinia is the seat of ancient volcanos, in groups of greater or less extent, and reposing in general, on the most recent rocks.

In general, the craters are effaced, but there are caps and currents of cellular lava, and there are pearlstone, obsidian, pumice, puzzolana, &c.

Spain, as appears by the high authority of Mr. Maclure, exhibits proofs of ancient volcanic action.

"Having passed the Pyrenees to go to Barcelona, he found in the bed of the *fluvia* lavas and scoriæ. He ascended towards the source of the river, traversed four leagues of a volcanic country, round Ollot, and observed there several streams of lava, volcanic cinders or Puzzolana, and lastly craters not yet effaced. This volcanic district extends from six to eight leagues to the south beyond Amera, where in 1428 there was an eruption which destroyed Ollot, and left only one house standing. He found much lava in the bed of the river Tor, and traversed near Massanite a current of ancient lava, almost a league in breadth, in a state of decomposition, and covered by an alluvial soil. From Massanite to Ollot, is a distance of fifteen leagues, so that the theatre of volcanic action in these countries is much more extended than that around Vesuvius."

The beautiful specimens of phosphat of lime, (asparagus stone,) found near Jumella, in Murcia, are deposited in ancient lava, lying under an old secondary compact shell limestone: the volcano was probably submarine.

Spain contains also other volcanic regions near Almeira, and in the chain of mountains that separates it from Portugal, near its southern extremity.

Portugal is not without volcanic appearances; in the vicinity of Lisbon, and in the Siera de l'Estrella, the ancient Herminius, there is an appearance of an ancient crater, containing a lake through which air bubbles arise.

Africa.

The islands that are contiguous to the African coast, are decidedly volcanic.

The Canaries are among the most remarkable; and of these, the most striking feature is

Teneriffe; whose highest peak, that of Teyde, is twelve thousand and ninety feet above the sea. The rocks composing this colossal structure are the productions of volcanic fire; but the basaltic rocks through which they have risen, are scarcely one third of the elevation of the peak itself.

"Hence we may characterize the two classes under the name of ancient and modern lavas, just as has been done in the case of those which are found at the foot, and which compose the mass of Mount Etna.

"The modern lavas however of the peak admit likewise of a two-fold division, 1st, into those composing the nucleus of the mountain, which are of a trachytic character, and appear to have been forced up through the midst of the older basalts, and 2dly, into the products of the volcanic action to which this central mass furnished an appropriate vent.

"The latter are very various in their nature and character: we may distinguish, first, the lavas, which have sometimes a stony, and sometimes a vitreous aspect; and secondly, the loose ejected masses, such as pumice, obsidian, and lapilli.

"Of the lavas, such as have a stony aspect, appear to be confined to a comparatively low elevation, and to have proceeded exclusively from the flanks of the volcano—whilst the vitreous are found only near the summit, the lowest point at which they occur being eight thousand nine hundred feet above the level of the sea."

There is however one vitreous current near the top of the mountain; and this region is covered with obsidian, and with showers of pumice, but they do not reach the lower parts of the mountain, which are mostly covered by rapilli, resembling lithoid lava, and not mixed with pumice or obsidian.

"This latter distribution, says Humbolt, seems to confirm the observation made a long time ago at Vesuvius, that the white ashes are thrown out last, and indicate that the eruption is at an end. In proportion as the elasticity of the vapours diminishes, the matter is thrown to a less distance; and the black rapilli, which issue the first, when the lava has ceased flowing, must necessarily reach father than the white rapilli. The last appear to have undergone the action of a more intense fire.

"The size of the crater that exists in the summit of the Peak is diminutive compared with that of Etna or of Vesuvius, being only three hundred feet in its greatest, and two hundred in its lesser diameter, whilst its depth does not exceed one hundred feet.

"Indeed it may be remarked in general, although the rule is liable to exceptions, that the dimensions of a crater are in an inverse ratio to the elevation of the mountain; for in proportion to the height which the ejected masses must attain before they reach the orifice, will be the resistance to be overcome in forcing a passage by this channel, so that in a mountain like the Peak of Teneriffe, the force applied will in most instances be instrumental in creating apertures in the flanks of the mountain, rather than in enlarging the cavity on its summit.

"The existence nevertheless of this chimney preserves the island in Von Buch's opinion from those destructive eruptions which convulse some of those adjoining it, since elastic vapours, the immediate and necessary concomitants, of volcanic action, thus find a readier vent, and confine their violence to the immediate precincts of the volcano.

"We must not however go so far as to suppose, that Teneriffe itself is altogether exempted from those convulsions of nature which are so common in the neighboring islands.

"Its lofty peak, although it may act as a safety valve, and moderate the violence of the volcanic action by determining it to a point at which it can obtain a vent, proves nevertheless from this very circumstance a dangerous neighbor to the towns that lie underneath it. In the years 1704 and 1706 lateral eruptions took place from the Peak the latter of which destroyed the port Garachico, the finest and most frequented harbor in the island. In 1798 too, the mountain Chahorra threw out lavas and scoriæ for the space of more than three months, and the violence of the eruption may be judged of by the fact mentioned by Humbolt on the authority of an eye witness; namely that considerable fragments of stones were thrown to such an height, that from twelve to fifteen seconds were reckoned during their descent. This curious observation proves, that rocks were projected from this crater to a height of three thousand feet and upwards.

"Before I conclude the subject we are upon, I may remark, how strikingly the difference between the volcanic products of Teneriffe illustrates the manner, in which the effects of heat are modified in such cases by the influence of pressure.

"At the bottom of the mountain are the basaltic lavas or tuffs, which being produced probably under the ocean, and at a very remote period, are compact and possess a stony fracture. Through these have been protruded the trachytes of the peak, which, having had the resistance of so large a body of rock to overcome, also possess a considerable degree of compactness.

"This conical and upheaved mass having become the centre of the volcanic operations subsequently carried on, is surrounded by products of later formation, some of which were ejected from the summit at a time when a free channel of communication existed between it and the interior of the volcano, others from the flanks at a later period, when the aperture had become obstructed by the falling in of its sides, or the accumulation of ejected substances. It is clear, that in either of these cases, the pressure exerted upon the substance whilst in a melted state was less considerable than that which prevailed during the formation of the submarine lavas, or even of the trachyte, and hence it is found to possess more of a vitreous aspect, and is more completely penetrated with cells. The pumice never covers any of the currents of lava, a proof of its greater antiquity. See Von Buch. In Leonh. Min. Tasch. 4 part. 1823."

Palma presents a very instructive scene. Like the other islands of this group, " the strata seem to have been elevated from the bottom of the ocean, by the force of elastic vapors; for they dip away in all directions from some central point, where a crater still exists to attest the former agency of elastic fluids."

" The beds are all intersected by dykes of granular basalt, which become more and more abundant as we proceed along the valley, until, at length the lofty wall of rock which bounds it, is covered with a net work of them.

" These beds all rise towards the crater, or, as it is called by the people, the great Caldera, a circular opening in the centre of the island, the depth of which is stated by Von Buch as exceeding five thousand feet. From its brim we are enabled to look down upon the abyss, and observe underneath us the terminations of the strata, which we have successively passed in our way to it. Viewed from this point they all appear horizontal, but this, as I observed in speaking of the Monte Somma, is an illusion, and arises from their terminations only being visible, and from their ranging at an equal elevation in every part of the circular wall, which bounds the internal cavity of the crater.

" The caldera of the Isle of Palma, says Von Buch, differs much from the crater of an ordinary volcano. Here are no streams of lava, no slags, no rapilli or ashes. Nor do we ever find the latter of such a circumference, or so profound and abrupt. Its general aspect seems to shew that it was formed by the pressure of those elastic fluids which raised the whole island above the level of the ocean, and changed the strata composing it from an horizontal to their present highly inclined position."

" Considering therefore that the crater in this instance is unattended with the usual phenomena of a volcano, and is even distinguished from the latter by the preceding characters, Von Buch has chosen to denote it by the name of " Erhebungs crater" or crater of elevation, and he proceeds to shew that the same distinctive title is applicable to many craters both among these islands and in other parts of the globe."

The Great Canary has a structure very similar to that of Palma; " the same heaving up of the strata round a central point, the same deep and abrupt vallies, (called barancas,) the same description of crater, exhibiting the successive out crops of the adjoining beds."

" The order of superposition in the latter is such as to illustrate apparently the gradation that often occurs in the character of volcanic products, and perhaps the manner in which they have been derived by successive changes from the fundamental granite. Lowest of all Von Buch descried the primitive rocks; then masses of trachyte; afterwards an aggregate consisting of angular fragments of the latter rock, forming either a conglomerate or a tuff, which alternate with one another several successive times; still higher an augite rock (dolerite) with felspar, interstratified with beds of rolled masses of the same composition, but of a cellular structure; then an amygdaloid; and last of all basalt."

Lanzerote has a similar structure, and had evidently a similar origin, but it has been since augmented by eruptions of volcanic matter upon its surface. It is unlike the other islands of this group, flat, without abrupt cones and lofty precipices, and with only one vestige of a crater, like those in Palma and the Grand Canary. Still there have been in this island, within the records of history, terrific and devastating eruptions, particularly in the year 1730.

"After a painful walk, (says Von Buch,) over a tract of harsh, undecomposed lava, I reached at length an eminence composed entirely of an accumulation of slag and lapilli, which were heaped in successive layers upon each other. In the centre was a crater walled in by precipitous rocks, of which one side was broken away by a lava which had proceeded from its interior. Within the compass of this hollow two other minor craters appear, which emitted at the time volumes of aqueous vapour mixed with sulphureous exhalations. Hence it is that the hill has obtained the name of Montagna di Fuego.

"It is impossible, continues Von Buch, to describe the scene of desolation, which presents itself from the summit of this crater. A surface of more than three square miles in a westerly direction is covered with black lava, in the whole of which space nothing occurs to break the uniformity of the prospect, but occasional small cones of basalt scattered over the plain.

"It is clear that this vast mass of lava is not derived from any one point; even the Montagna di Fuego appearing to have contributed but little to its formation, for the lava actually proceeding from the latter is found to take an easterly instead of a westerly direction. During my ascent, I felt very anxious to ascertain, what the other sources might be which assisted in emitting so vast a mass of lava. How much was I astonished, when on reaching the summit I perceived an entire series of cones, all nearly as lofty as the Montagna di Fuego, placed so exactly in a line, that the nearest covered the farther ones in such a manner, that their summits alone were seen peeping from behind.

"Between the western coast and the little village of Florida, I counted twelve cones of larger size, of which the Montagna di Fuego was the sixth in the series, besides a considerable number of smaller cones, partly between and partly on the side of the larger ones. It was an exact repetition of the phenomena of Jorullo, or of the puys in Auvergne. The whole of this eruption proceeded in all probability from a large fissure, the existence of which is in all cases found to produce effects of the more alarming kind, the more distant it is from any volcano, the latter serving as a sort of chimney for the escape of the matter within.

"On my road to Florida, I visited several such cones. They all alike consist of heaps, three or four hundred feet in height, of harsh, porous, sharp lapilli, of the size of a bean, which cause a grating sound when they roll upon each other.

"These craters open for the most part towards the interior of the island, where the streams of lava unite to form one vast continuous bed, which, the farther we trace it from its source, is found to be less and less charged with olivine."

These devastations took place in the island, between the 1st of September, 1730, and the 16th of April, 1736, during which period of less than five years and an half, the miserable inhabitants being perpetually in terror, on account of the flames and smoke, ejected fragments and currents of lava, the gaseous exhalations which destroyed their cattle, and other frightful phenomena; the most fertile part of the island being covered with ruins, and despairing that the eruptions would ever cease, abandoned their homes and took refuge in the Great Canary. During these eruptions, flames rose from the midst of the sea. After this, the island enjoyed a period of repose for eighty-seven years; for on the 29th of August, 1823, a volcano broke out a league from the harbor of Rescif, and half a league from the mountain called Famia.

It vomited from its crater, terrible flames which lighted up the whole island, and enormous ignited stones, which in less than twenty-four hours formed a mountain of considerable size. It continued to burn over a space of half a league in length, and a quarter in breadth, for some days, and three weeks after poured forth a torrent of water.

The island of Madeira—according to Von Buch, is "formed after the same manner as the Canaries, consisting of beds which have been elevated above the level of the ocean by elastic fluids, but destitute of any crater from whence smoke and lava have been ejected."

The Cape de Verd Islands are little known (geologically,) but "they are said to consist principally of volcanic matter, and the island of Fago contains an active volcano."

The Azores are thoroughly volcanic. Dr. J. W. Webster, of Boston, U. S. Am. has given us a very interesting account of them.* Trachyte, obsidian, pumice, &c. abound there. There is an ancient crater in St. Michael fifteen miles in circumference, containing a lake and the rest covered with vegetables and a thin population. There are great caverns in the lava like those observed in Iceland by Sir George Mackensie, and in them hang the congealed droppings, in the form of stalactites—curious arborescent figures, &c.

In St. Michael there are hot springs charged with carbonic acid and sulphuretted hidrogen gases and a siliceous sinter is deposited, similar to that of the Geysers in Iceland. That volcanic energy is still active beneath the seas in this region, is evident, from the remarkable occurrence of the rise of a volcanic island through the ocean.

"In the year 1811 a phenomenon occurred, similar in kind to that, which I have already described, as having happened in the Grecian Archipelago. After a succession of earthquakes, experienced more or less sensibly in all the neighboring parts, a new island arose in the midst of the sea, of a conical form, and with a crater on its summit, from which flame and smoke continually issued. The island, when visited soon after its appearance by the crew of the frigate Sabrina, was about a mile in circumference, and two or three hundred feet above the level of the ocean, it continued for some weeks, and then sunk again into the sea."

Dr. Webster has given drawings and a very interesting description of this remarkable occurrence so instructive in the history of volcanos.

Among the Azores, El Pico is the only one which contains a volcano at present in activity; its summit is not less than nine thousand feet above the sea; it consists of a conical mass of trachyte, and is constantly emitting smoke.

Ascension Island is of volcanic origin, containing abundance of ignigenous materials, particularly in a hill about seven hundred feet above the sea, in which is a hollow, probably a crater now filled with volcanic substances. The island

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* See the notice of Dr. Webster's work, Vol. IV, page 251 of this Journal.

is very rugged and forbidding; its highest mountain is two thousand eight hundred and eighteen feet above the sea, and is covered with pumice sustaining a thin soil.

St. Helena rendered memorable as the prison and grave of Napoleon, was probably raised out of the sea, by volcanic action. In the interior of the island, is a crater called the devil's punch bowl; its dimensions are in two diameters, one thousand and seven hundred yards, and it is two hundred and fifty yards deep.

The Isle of France, on the eastern side of Africa is itself a conical mountain, as it rises on all sides towards the center, and there is besides a range of mountains, all of which consist of volcanic matter, either lava or basalt.

Bourbon has a similar character; it slopes on all sides upward towards a centre, and consists of two volcanic mountains of different ages: the southern, which is the smallest, being still active, while the western is extinct. Earthquakes are sometimes experienced in those parts of the island that are most remote from the active volcano.

This volcano produces a variety of pumice, resembling spun glass, similar to that which is so abundantly produced at Hawaii (Owyhee.)

Africa is fringed with volcanic islands, but it is still perhaps doubtful whether there is any active volcano, whose existence is well established, on the African continent, although many circumstances, mentioned by ancient authors, would lead to the presumption that some portion of the chain of Atlas is of this character, and modern travellers lead us to suppose that some of the mountains of Egypt and Lybia are referrible to the same class.

Asia.

Asia and its islands abound with volcanos, and whatever may be said of Egypt, there is no doubt of their existence on the opposite shore and in the Red Sea itself. Bruce describes an active volcano in the island of Zibbel Teir, in north latitude 16°, and other volcanic appearances are described as existing about Suez; the Arabian gulph at Donnar, Medina, &c. We must refer our readers to Professor Daubeny's work for the course of investigation, which leads him to conclude that Palestine has been the scene of extensive volcanic agency, and that the very imagery and allusions of the sacred writers, especially of the prophets, were often drawn from these physical occurrences.* The author has rendered it very probable, that volcanic agency was the physical instrumen, employed by the Almighty, to destroy the five cities of the plain, that the Salt or Dead Sea arose either from the subsidence of the plain or from the damming of the Jordan,† by a current of lava; that the showers of fire and brimstone were occasioned by the fall of volcanic ejections, and Mr. Henderson, the celebrated missionary traveller in Iceland, imagines that Lot's wife, lingering behind her friends, may have been first suffocated, and then incrusted with saline and other volcanic materials.

"That the volcanic eruption which destroyed the cities of the Pentapolis was accompanied by the flowing of a stream of lava, may be inferred, (says our author,) from the very words of scripture. Thus when Eliphaz reminds Job of this catastrophe, he makes use of the following expressions, according to Henderson's translation of the passage:—

Hast thou observed the ancient tract
That was trodden by wicked mortals?
Who were arrested on a sudden,
Whose foundation is a *molten flood.*
Who said to God; depart from us,
What can Shaddai do to us?
Though he had filled their houses with wealth;
(Far from me be the counsel of the wicked!)
The righteous beheld and rejoiced,
The innocent laughed them to scorn;
Surely their substance was carried away,
And their riches devoured by fire. Job xxii. 15—20."

"The Phlegrean fields, (in the words of Dr. Clarke,) and all that can present an idea of volcanic destruction, form but a feeble image of the frightful country through which I passed. From the bridge of Jacob to Sassa, the whole ground is composed of nothing but *lava, basalt, and other* volcanic productions; all is black, porous, or carious; it was like travelling in the infernal regions. Besides these productions, which cover the country, either in detached masses, or in loose strata, the surface of the ground is entirely covered with loose *volcanic stones*, from three to four inches in circumference to a foot in diameter, all equally black, porous, or carious; as if they had just come out of the crater. But it is particularly at

* See Nah. i. 5, 6. Mic. i. 3, 4. Isai. xiv. 1, 3. Jer. iv. 25, 26.
† He supposes that the Jordan may have formerly flowed into the Mediterranean or into the Red Sea.

the approaches to Sassa, that the traveller meets with groupes of crevices, and volcanic mounds, of so frightful a size, that he is seized with horror, which is increased if he allows his imagination to wander to the period, when these masses were hurled forth with violence from the bowels of the earth. There are evident signs that all this country was formerly filled with volcanos, for we beheld several small craters in traversing the plain."

Our author is inclined, likewise, to conclude, that the country around the lake of Tiberias is volcanic.

It is obvious that these general views concerning the volcanic features of this country are not inconsistent with the late statements of the American missionaries,* confirmed by specimens, which go to prove that a great deal of Palestine is composed of transition and secondary limestone; for volcanic eruptions occasionally visit nearly every variety of geological formation, and the currents and ejections cover them and intrude among them wherever they may chance to be driven.

Although there are now, no eruptions in Palestine, there are still earthquakes as in ancient times—"which changed the face of Antioch, Laodicea, Tripoli, Berytus, Tyre and Sidon." In 1759, there happened one which destroyed twenty thousand persons, in the valley of Balbec. For three months the shocks so much terrified the inhabitants of Lebanon that they abandoned their houses and dwelt under tents. Very recently, and even within three or four years, Antioch has been severely shaken and the lives of many people destroyed.

We shall not occupy our readers long with the interior of Asia. There seems to have been, in 1737, a volcano near Scandaroon, and near Smyrna there is a district of country which from its burnt and arid appearance was called κατακεκαυμενη. Strabo says, "it is without trees with the exception of the vine; the surface of the ground is cindery and the mountains and rocks are black as if they had been calcined." Strabo mentions volcanic appearances in the neighborhood of Laodicea. Mr. Brown, the African traveller says:

"My eyes have been very much opened in this journey, to the volcanic nature of certain parts of Asia Minor and its confines. At Kôlah, near the Hermus, only three days from Smyrna, may be seen an unquestionable site of volcanic eruption.

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* See Vol. IX, page 337, and Vol. X, page 21, of this Journal.

It is one of the most recent, though still probably of a very remote period. Carabignar is another, but this probably may have been noticed by others. Kôlah, I imagine, has not hitherto been observed. I shall have something to say of Afium Karahissar. The neighborhood of Konié, and still more of Kaisarié, is overspread with fragments of lava, some of it almost in the state of scoriæ. The quantity of lava in the district of Erzerûm is immense, and the whole country about Mount Ararat is volcanic. The eruptions in these places seem to be of great antiquity."

Caucasus exhibits rocks containing glassy felspar, and Mount Ararat presents extensive volcanic remains, but although there are rumors of eruptions, there is no account that can perhaps be distinctly relied upon.

Between the Caspian and the Black Sea, there are volcanic appearances, pumice, glassy felspar, &c. in this portion of the range of Caucasus. It would seem that the following statement respecting an occurrence in the island of Azof, countenances the idea of volcanic action there.

"The account is, that on the 10th of May in that year, a frightful noise was heard in the sea, round a distance of two hundred toises. Flames rose from the water, accompanied by explosions as loud as those of a cannon. A thick smoke was blown about by the violence of the wind, and enormous masses of earth were seen thrown up in the air, together with large stones.

"Ten eruptions of this kind took place at intervals of a quarter of an hour. Similar phenomena continued during the night. There then rose out of the sea an island, which threw out from several apertures a muddy substance, that acquired by degrees some consistency.

"During this time, a remarkable smell, which had nothing of a sulphureous nature, was perceived over a space of ten wersts. On the 20th of April, a nearer examination of the island was undertaken, and it was found almost inaccessible, being surrounded on all sides with hardened mud. When they had at last succeeded in reaching the interior of the island, its height above the level of the sea was found to be a toise and a half, and its surface was seen to be every where covered with a stony material of a whitish color."

"In the chain of Elbur's which bounds the Caspian Sea on the south, there occurs a lofty mountain called Dervavend, which has long been noted as a volcano:" it exhibits lava and columnar basalt, and sometimes emits smoke; sulphur is found in small craters near its base, and the Persian fables have buried beneath it Zohag, one of their tyrants, whose struggles agitate this mountain, as those of Typhoeus did Etna.

From India the accounts of volcanic appearances are few and scanty.

The island of Salsette, near Bombay, is basaltic, and a volcano emitting smoke, but not flame, is said to have been discovered in the Himalaya mountains.

In China and Tartary it would appear that there are several volcanic mountains in a state of activity. The mountain Ho-chan, to the north of Khouei-thsu, is said to throw out stones in a burning and melted state; the lava first flows and then congeals. Sal-ammoniac is obtained from this mountain: it forms a part of the snowy chain of the celestial mountains. Sal-Ammoniac, which, when formed by nature, always indicates a volcanic country, is produced in two mountains in central Tartary; the one, the volcano of Tourfair, the other, the white mountain; these two mountains throw out, continually, flames and smoke; these volcanos are one thousand and two hundred miles from the Caspian. They obtain Sal-Ammoniac there which the people collect by entering into hot caverns, with wooden shoes, as those of leather would be burnt. (See Ferussac's Bulletin, Vol. 3, 1824.) The number of volcanos and solfaterras, in central Asia, does not appear to be determined. Pallas, in 1770, visited one in the government of Orenberg, near Soulpa, which threw out smoke by day and light flames at night.

"The only active volcanos on the Continent of Asia, that appear to be fully ascertained, are those on the Peninsula of Kamtschatka.

"Kraskeninikoff, in his history of that province, translated into French in 1767, makes mention of three; viz.

"1. Awachinski, north of the bay Awatscha, which had an eruption in 1737, followed by a tremendous earthquake, during which the sea overflowed the land, and afterwards receded so far, as to leave its bed, between the first and second of the Kurule Islandss, dry.

"2. Tulbatchinski, situated on a tongue of land between the rivers of Kamtschatka and Tulbatchik. Its first eruption took place in 1739, and caused the country for 50 wersts to be covered with ashes.

"3. Kamtschatka Mountain, the loftiest in the country. It was in a state of eruption in 1737, the same year in which the mountain Awachinski was in activity. It continued for a week to throw out streams of lava with great vehemence. Since that time it usually ejects ashes and scoriæ three or four times a year.

"Besides the above, there are said to be two which only emit smoke, and two which are extinct. They appear to be all situated about the southern part of the Peninsula.

"From Kamtschatka we may, to all appearance, trace a line of volcanic operations along the chain of the Aleutian Islands to the Peninsula of Alaschka in North America, where indications of the same kind are said to occur. Among the Aleutian groupe, Langsdorf has described a rock near the Island of Unalaschka, three thousand feet in height, consisting of trachyte, which made its appearance in 1795, and seems to have been thrown up all at once from the bottom of the ocean, and not formed by successive accumulations of ejected materials."

"The volcanos of Kamschatka are connected again in the south with those of Japan, by means of the Kurule Islands, where no less than nine active volcanos occur according to Krascheninikou.

"In the islands of Japan ten volcanos have been enumerated, but little is known concerning them."

"Langsdorff particularly mentions a volcano in Satzuma bay, into the crater of which the Christian proselytes were thrown if they would not renounce their faith, during the severe persecution carried on against them in the last century.

"From the southern point of Japan, a chain of headlands is continued along the groupe of Loo Choo to Formosa, and thence to the Philippine Islands.

"Off Loo Choo, Captain Hall discovered an isolated rock, on which was the crater of a volcano reduced apparently to the condition of a solfatara. Its sides were stratified, as were also the rocks on the south side of the Island, which are penetrated with great dykes of a material more durable than the stone they intersect, and therefore standing out to a considerable distance in relief from the face of the rock.

"The Island of Formosa is described by Klaproth in Maltbrun's voyages, and in the Asiatic Journal for December, 1824. A high chain of mountains, which is covered with snow in November and December, stretches across the country. Abundance of salt and sulphur is met with, and flames are said to rise occasionally from the waters of the lakes and from the ground. There is a tradition as to the summit of one of these mountains having become the seat of a volcano. There is said to be on the top of the mountain, called Pa-lee-fen-shan, a block of iron of the highest antiquity, to which the natives attribute many extraordinary qualities.

"Lucon one of the Philippine Islands, contains three active volcanos, one of which, Taal, south of Manilla, had an eruption in 1754.

"The Islands of Fugo, and Magindanao likewise, each contain a burning mountain.

"We know nothing of the volcanos said to exist in Borneo, but it appears that the Andaman Islands, west of Pegu, and north of Sumatra, contain one in activity, called Barren Island, nearly four thousand feet in height, which frequently emits vast columns of smoke, and red hot stones three or four tons in weight."

In Sumatra the volcano of Priamang, twenty miles inland from Bencoolen, sends forth smoke, and the inhabitants are alarmed when the vents are tranquil, because they then expect earthquakes.

In a plain between Bencoolen and Palembang, rises the mountain of Gunong Dempo, twelve thousand feet above the sea, and the highest in the island; it is almost constantly emitting smoke and hot springs, and other volcanic phenomena are common in the neighborhood.

Java, in its whole extent, is penetrated by volcanic mountains, rising from five to eleven, and even twelve thousand feet. There are thirty-eight mountains in this range, which however differing in form, in other particulars agree in "having a broad base, gradually verging towards the summit in the form of a cone."

"They all rise from a plain but little elevated above the level of the sea, and each must, with very few exceptions, be considered as a separate mountain, raised by a cause independent of that which produced the others. Most of these have been formed at a very remote period, and are covered, by the vegetation of many ages; but the indications and remains of their former eruptions are numerous and unequivocal. The craters of several are completely extinct; those of others contain small apertures, which continually discharge sulphureous vapours and smoke. Many of them have had eruptions during late years. Almost all the mountains or volcanos in the large series before noticed, are found on examination to have the same general constitution; they are striped vertically by sharp ridges, which, as they approach the foot of the mountain, take a more winding course."

There are also various ridges of smaller volcanic mountains.

Professor Daubeny inspected a collection of the modern lavas of Java, and thought them very similar to those of Vesuvius; several of them contained leucite, and there were also specimens of pitchstone, which, as was stated, formed dykes. Dr. Horsfield relates the following astonishing instance of volcanic action:—

"The Papandayang, situated on the south western part of the island, was formerly one of the largest volcanos, but the greater part of it was swallowed up in the earth, after a short but severe combustion in the year 1772. The account which has remained of this event asserts, that near midnight, between the 11th and 12th of August, there was observed about the mountain an uncommonly luminous cloud, by which it appeared to be completely enveloped. The inhabitants, as well about the foot, as on the declivities of the mountain, alarmed by the appearance, betook themselves to flight; but before they could all save themselves, the mountain, began to give way, and the greatest part of it actually *fell in*, and disappeared in the earth. At the same time a tremendous noise was heard, resembling the discharge of the heaviest cannon. Immense quantities of volcanic substances, which were thrown out at the same time and spread in every direction, propagated the effects of the explosion through the space of many miles.

"It is estimated, that an extent of ground, of the mountain itself, and its immediate environs, fifteen miles long and six broad, was by this commotion swallowed up in the bowels of the earth. Several persons, sent to examine the condition of the neighborhood, made report, that they found it impossible to approach the mountain, on account of the heat of the substances which covered its circumference, and which were piled on each other to the height of three feet, although this was the 24th of September, and thus full six weeks after the catastrophe. It is also mentioned that forty villages, partly swallowed up by the ground, and partly covered by substances thrown out, were destroyed on this occasion, and that two thousand nine hundred and fifty seven of the inhabitants perished.

"The mountain of Galoen-gong, which had never been reckoned among the volcanos of the island, broke out with terrific violence in 1822. The eruption began by a tremendous explosion of stones and ashes, followed by a stream of lava which covered a large tract. Four thousand persons were destroyed."

In the centre of the plain, which interrupts the large series of volcanos, there is a mud eruption, a large hemisperical mass of black earth and water, about sixteen feet in diameter; after rising to the height of twenty or thirty feet in a perfectly regular manner, as if it were pushed by a force beneath, it suddenly explodes with a dull noise, and scatters black mud in every direction; this phenomenon is repeated at intervals of from two to five seconds, and is attributed to the general causes of volcanic action existing in the island. These explosions are never violent; they are attended by a smell like naptha. The Javanese have a tradition, and their records even assign the date of the events, that Java, Sumatra, Bali, and Sumbawa, were once united. However this may be, the volcanos of Java and of the Philippine groupe appear almost connected with one another, through the medium of those which exist in Sumbawa, Flores, Daumer, Banda, and the Moluccas.

"That of Tomboro in the Island of Sambawa is perhaps one of the most considerable in the world, according to the description given of it by Sir Stamford Raffles.

"Almost every one, says this writer, is acquainted with the intermitting convulsions of Etna and Vesuvius, as they appear in the descriptions of the poet, and the authentic accounts of the naturalist, but the most extraordinary of them can bear no comparison, in point of duration and force, with that of Mount Tomboro in the Island of Sambawa. This eruption extended perceptible evidences of its existence, over the whole of the Molucca Islands, over Java, a considerable portion of Celebes, Sumatra, and Borneo, to a circumference of a thousand statute miles from its centre, by tremulous motions and the report of explosions; while, within the range of its more immediate activity, embracing a space of three hundred miles around it, it produced the most astonishing effects, and excited the most alarming apprehensions. In Java, at the distance of three hundred miles, it seemed to be awfully present. The sky was overcast at midday with clouds of ashes, the sun was enveloped in an atmosphere, whose "palpable density" he was unable to penetrate; a shower of ashes covered the houses, the streets, and the fields, to the depth of several inches, and amid this darkness, explosions were heard at intervals, like the report of artillery, or the noise of distant thunder.

"At Sambawa itself three distanct columns of flame appeared to burst forth, near the top of the Tomboro mountain, (all of them apparently within the verge of the crater,) and after ascending separately to a very great height, their tops united in the air in a troubled, confused manner. In a short time, the whole mountain next Sang'ir appeared like a body of liquid fire, extending itself in every direction.

"The fire and columns of flame continued to rage with unabated fury, until the darkness, caused by the quantity of falling matter, obscured it about eight P. M. Stones at this time fell very thick at Sang'ir, some of them as large as two fists, but generally not larger than walnuts. Between nine and ten P. M. ashes began to fall, and soon after, a violent whirlwind ensued, which blew down nearly every house in the village of Sang'ir, carrying the alaps, or roofs, and light parts away with it. In the port of Sang'ir adjoining Sambawa, its effects were much more violent, tearing up by the roots the largest trees, and carrying them into the air, together with men, horses, cattle, and whatever else came within its influence. (This will account for the immense number of floating trees seen at sea.) The sea rose nearly twelve feet higher than it had ever been known to do before, and completely spoiled the only small spots of rice land in Sang'ir, sweeping away houses and every thing within its reach. The whirlwind lasted about an hour. No explosions were heard till the whirlwind had ceased, at about eleven A. M. From midnight till the evening of the 11th, they continued without intermission; after that time their violence moderated, and they were heard only at intervals, but the explosions did not cease entirely till the 15th of July. Of all the villages round Tomboro, Tempo, containing about forty inhabitants, is the only one remaining. In Pekaté no vestige of a house is left: twenty-six of the people, who were at Sumbawa at the time, are the whole of the population who have escaped. From the best enquiries there were certainly not fewer than twelve thousand individuals in Tomboro and Pekaté at the time of the eruption, of whom five or six survive. The trees and herbage of every description, along the whole of the north and west of the peninsula, have been completely destroyed, with the exception of a high point of land near the spot where the village of Tomboro stood. At Sang'ir it is added the famine occasioned by this event was so extreme, that one of the rajah's own daughters died of starvation."

"In the Island of Timor, the volcano of the *peak* served, like that of Stromboli, as a sort of light-house, seen at more than three hundred miles distance. In 1637, this mountain, during a violent eruption dissappeared entirely: a lake at present takes its place.

"The Island of Daumer is also said to contain a volcano, and Dampier in 1669 saw one burning between Timor and Ceram.

"Goonung-Api,* one of the Banda Islands, contains an active

* It appears from Marsden's Sumatra that this word signifies in the Malay language volcano.

volcano, which had an eruption in 1820, and ejected red-hot stones of prodigious size."

Among the Moluccas there are two volcanos in the islands of Tervati and Tidore, and in the island of Machian, a mountain was rent from top to bottom, in the year 1646, emitting horrible streams of smoke and flame, and now stands divided into two distinct eminences.

In New Guinea, south latitude 5° 33′, Dampier discovered an active volcano.

"The volcano in the Island of Sang'ir, one of the largest in the world, seems to connect those last mentioned with the burning mountain which I have before described as existing among the Philippines, thus appearing to establish a line of communication between those of Kamschatka and of the Indian Sea."

"In the Great Pacific Ocean, the islands, according to Kotzebue, may be referred to two classes, distinguished by their elevation into high and low. The latter class appear to be entirely of modern formation, the product of that accumulation of coral reefs, which Flinders and others have described in so interesting a manner.

"The high islands on the contrary are chiefly volcanic, though in the Friendly and Marquesa Islands primitive rocks occur, and in Waohoo porphyry and amygdaloid.

"The Mariana or Ladrone Islands constitute a sort of mountain chain, consisting of a line of active volcanos, especially towards their north, which is parallel to that of the Phillippine groupe, whereas the islands that lie detached in the middle of the basin, of which these two groups are the boundaries, seem for the most part to be extinguished.

"The Island of Ahrym, in the groupe of the New Hebrides, contains an active volcano, and the same thing is stated by Forster with regard to that of Tanna. A volcano is said by Kotzebue to be burning in Tofua, one of the Friendly Islands."

The island of Owyhee is one of the grandest scenes of volcanic action in the world; but having given in this Journal, Vol. XI, page 1, a full abstract and analysis of Mr. Ellis' Missionary Tour, to which we are indebted for a very full and interesting account of this volcanic island, and having published also, the account of the Rev. Mr. Stewart, Vol. XI, page 362, describing his descent with Lord Byron and party into the great crater of Kirauea, we shall abstain from any citations from this part of Prof. Daubeny's work.

Among active volcanos, we believe that the crater of Kirauea is unparalleled for magnitude and depth, and its situation in the midst of a vast elevated plain is also peculiar; we subjoin the following short additional notice of it from a news paper.

Hawaii.

"*Crater of Kirauea.*—Jan. 5, 1826, Mr. Bishop, the Missionary at Hawaii, visited this volcano. He says, we started early on our way. Before we had travelled far, the sulphureous vapour, the wind being ahead, became very perceivable, and indicated our approach to the volcano. For many miles before we arrived there, the air was so much charged with this vapour, as to be very offensive, and, at times almost suffocating. We arrived at the crater about eleven o'clock, by a path which led around to the southern side, at this time the windward, our approach to the other quarter being deemed unsafe. We found the crater much altered from what it was in the summer of 1823, when I visited it in company with Mr. Ellis, and others. I was greatly surprised to find, that since the visit of Lord Byron and company in June last, the crater had been filled, apparently to the height of more than five hundred feet with fresh lava. The smoke ascended in immense columns from a hundred blazing furnaces, and completely obscured the sides on the north and east, together with a greater part of the interior of the volcano. As the wind occasionally blew away the smoke, I could discover an immense number of fires, some spouting forth from cones that arose to the height of fifty or one hundred feet above the surface of the surrounding crust of lava; and others boiling with the greatest agitation, like vast caldrons of liquid fire, and every now and then sending forth a gust of vapour and smoke with great noise, when the view would again be obscured. The natives inform me, that after rising a little higher, the lava will discharge itself as formerly, towards the sea, through some aperture under ground."

"Other volcanos, (says Prof. Daubeny,) are stated to occur in different parts of that extensive tract, known by modern geographers under the name of Polynesia, as far as to New Caledonia and the New Hebrides. The separate mass of New Zealand, with which Norfolk Island is connected, may be viewed as the southern end of the Bulwark; its eastern can hardly be fixed at any nearer point than the coast of America, for I am assured that an active volcano at present exists among the Galapagos, only 10 deg. West of Quito.

"Far therefore from believing that volcanos have been instrumental in the destruction of continents, or that their history lends any countenance to the fables respecting the Atlantis, we should rather be led to consider that they were more generally among the means which nature employs for increasing the extent of dry land, and for gradually converting an unprofitable tract of ocean into an abode for the higher classes of animals."

Volcanos of America.

West Indian Archipelago.—The West Indian islands are geologically divided into

1. Primitive.
2. Volcanic.
3. Calcareous.
4. Volcanic and calcareous, with organized remains.

To the first class belong Trinidad, Cuba, St. Domingo, Portorico, and in part Jamaica, which contains also transition, secondary, and tertiary rocks, and there are rocks supposed to be volcanic at Black hill, between Lennox, Low Layton and the sea. Trinidad is in fact an appendage of the South American continent.

The most remarkable circumstance in its geology is the celebrated pitch lake, existing in the midst of a clayey soil: it is three miles in circumference, firm in the wet season, but almost fluid in the hottest weather. Probably its origin is connected with volcanic action, especially as there is on the eastern coast a pit which throws up asphaltum with explosions of smoke and flames. A similar vent exists in the sea to the west of the island.

"Of the second class of islands, which consist exclusively of volcanic rocks, the follwing is a summary, commencing with the most southern.

"1. Grenada, an extinct crater filled with water; boiling springs; basalts between St. George and Goave.

"2. St. Vincent, an active volcano, called Le Souffrier, the loftiest mountain in the chain which runs through the islands. It first threw out lavas in 1718, but its most tremendous eruption was in 1812, when there issued from the mountain so dreadful a torrent of lava, and such clouds of ashes, as nearly covered the island, and injured the soil in a manner which it has never yet recovered. The total ruin of the city of Caraccas preceded this explosion by thirty-five days, and violent oscillations of the ground were felt both in the islands, and on the coasts of Terra Firma.

"3. St. Lucia contains a very active Solfatara, from twelve to fourteen hundred feet in height. Besides a considerable condensation of sulphur given out from the crevices, jets of hot water likewise take place, which fill periodically certain small basins like the Geysers of Iceland.

"4. Martinique can hardly be said to belong to this class, for limestone is seen resting upon the volcanic products.

"The latter however constitutes the fundamental rock throughout the whole island, and forms three principal hills called Vauclin, the paps of Carbet consisting of felspathic lava, which are the most elevated summits in the whole of this series of islands, and montagne Pelèe. Between the first and second of these is found in a neck of land a tract composed of ancient basalts, called La Roche Carrée. Hot springs at Prêcheur and Lameutin.

"5. Dominica is completely composed of volcanic matter, but the action is extinct.

"6. Gaudeloupe may be divided into two parts, according to its physical structure.

"The first, properly called Gaudeloupe, consists entirely of volcanic rocks, and therefore belongs to this division of our subject; the second named Grande Terre, is calcareous, consisting of a shelly limestone, covered by a bed of clay, and containing rolled masses of lava. The volcanic part of the island contains fourteen ancient craters, and one in a state of present activity. The eruption of 1797 took place from an elevation of four thousand eight hundred feet. Pumice, ashes, and clouds of sulphureous vapours were then ejected. The particulars are given in the report made to the French government on the state of the volcano in 1797 by Mons. Amie.

"7. Montserrat—a Solfatara; fine porphyritic lavas, with large crystals of felspar and hornblende, near Galloway, often much decomposed by the sulphureous exhalations.

"8. Nevis—a Solfatara.

"9. St. Christopher's—a Solfatara at mount Misery.

"10. St. Eustachia—the crater of an extinguished volcano, surrounded by pumice.

"The third class comprehends the islands of Margarita, Desirade, Curacoa, Bonaire, and in general all the islands of low elevation; they consist entirely of limestone of very recent formation.

"The fourth class, partly composed of volcanic products, and partly of shelly limestone, comprises the Islands of Antigua, St. Barthelemi, St. Martins, and St. Thomas.

Antigua is remarkable for its siliceous petrifactions. (See Vol. I, page 56, and 140, and Vol. XII, page 378, of this Journal.)

"The process, by which these islands, according to Moreau de Jonnes, are in many instances formed, is sufficiently curious; first a submarine eruption raises from the bottom of the sea masses of volcanic products, which as they do not rise above the surface of the water, but form a shoal a short way below its surface, serve as a foundation on which the Madreporites and other marine animals can commence their superstructure. Hence those beds of recent coralline limestone, seen covering the volcanic matter in many of the islands."

Some valuable geological information respecting the West India islands may be found in the report of Mr. William Maclure, the celebrated American geologist, in the Journal de Physique.

Continental America.

Californa.—There are three active volcanos in the peninsula of Californa; Mount St. Elia, seventeen thousand eight hundred and seventy-five feet high, being the highest land in North America. Mount del Buen Tiempo, and volcano de las Virgines.

Mexico.—In this country, in the 24th degree of north latitude, commences that great volcanic chain which extends with little interruption to the 2d degree of south latitude.

The first active volcano is in the parallel of the city of Mexico itself.

"And here almost in the same line occur five, so placed that they appear to be derived from a fissure traversing Mexico from west to east, in a direction perpendicular to that of the great mountain chain, which extending from north-west to south-east, constitutes the great table land of the American Continent. It is interesting to remark, that if the same parallel line, which connects the active volcanos of Mexico, be prolonged in a westerly direction, it would traverse the groupe of islands called the Isles of Revillagigedo, which there may be reason to consider volcanic from the pumice found amongst them."

The most eastern is a few miles northwest of Vera Cruz, it is called Tuxtla and had a considerable eruption in 1793, on which occasion, the ashes were carried fifty-seven leagues to Perote.

Further to the west is the volcano of Orizaba, seventeen thousand and three hundred feet high, and the peak of Popocateplt seventeen thousand and six hundred feet high, and the most lofty eminence in New Spain ; " the latter is continually burning, but for two or three centuries has thrown nothing from the crater but smoke and ashes."

" On the western side of the city of Mexico, are the volcanos of Jorullo and Colima. The elevation of the latter is estimated at about nine thousand feet. It frequently throws up smoke and ashes, but has not been known to eject lava.

" The volcano of Jorullo, situated between Colima and the town of Mexico, is of much more modern date than the rest, and the great catastrophe which attended its first appearance, is perhaps, (says Humboldt) one of the most extraordinary physical revolutions in the annals of the history of our planet.

" Geology points out parts of the ocean near the Azores, in the Egean sea, and to the south of Iceland, (?) where, at recent epoques, within the last two thousand years, small volcanic islands have risen above the surface of the water ; but it gives us no example of the formation, from the centre of a thousand burning cones, of a mountain of scoriæ and ashes one thousand six hundred and ninety-five feet in height, comparing it only with the level of the adjoining plains, in the interior of a continent, thirty-six leagues distant from the coast, and more than forty-two leagues from every other active volcano.

" A vast plain extends from the hills of Aguasarco nearly to the villages of Teipa and Pelatlan, both equally celebrated for their fine plantations of cotton. Between the Picachos del Mortero, the Cerros de las Cuevas, and de Cuiche, this plain is only from two thousand four hundred to two thousand six hundred feet above the level of the sea. In the middle of a tract of ground in which porphyry with a greenstone base predominates, basaltic cones appear, the summits of which are crowned with vegetation, and form a singular contrast with the aridity of the plain, which has been laid waste by volcanos.

" Till the middle of the last century, fields covered with sugar-cane and indigo occupied the extent of the ground between the two brooks called Cuitimba and San Pedro. They were bounded by basaltic mountains, the structure of which seems to indicate, that all this country, at a very remote period, had been already several times convulsed by volcanos. These fields, watered by artificial means, belonged to the farm of Don Pedro di Jorullo, and were among the most fertile in the country.

"In the month of June, 1759, a subterraneous noise was heard. Hollow sounds of the most alarming nature were accompanied by frequent earthquakes, which succeeded each other for from fifty to sixty days, to the great consternation of the inhabitants of the farm. From the beginning of September every thing seemed to announce the complete re-establishment of tranquillity, when in the night of the 28th and 29th, the horrible subterraneous noise recommenced. The affrighted Indians fled to the mountains of Aguasarco. *A tract of ground from three to four square miles in extent rose up in the shape of a bladder.* The bounds of this convulsion are still distinguishable from the fractured strata.

"The Malpays near its edges is only thirty-nine feet above the old level of the plain, called *Las Playas de Jorullo;* but the convexity of the ground thus thrown up increases progressively towards the centre to an elevation of five hundred and twenty-four feet.

"Those who witnessed this great catastrophe from the top of Aguasarco assert, that flames were seen to issue forth for an extent of more than half a square league, that fragments of burning rocks were thrown to prodigious heights, and that through a thick cloud, of ashes, illumined by volcanic fire, the softened surface of the earth was seen to swell up like an agitated sea. The rivers of Cuitimba and San Pedro precipitated themselves into the burning chasms. The decomposition of the water contributed to invigorate the flames, which were distinguishable at the city of Pascuaro, though situated on a very extensive table land, four thousand five hundred and ninety-two feet above the plains of Las Playas de Jorullo. Eruptions of mud, and especially of strata of clay, enveloping balls of decomposed basalt in concentrical layers, appear to indicate that subterraneous water had no small share in producing this extraordinary revolution. Thousands of small cones, from six to ten feet in height, called by the natives *ovens* (hornitos) issued forth from the Malpays. Although, according to the testimony of the Indians, the heat of these volcanic ovens has suffered a great diminution during the last fifteen years, I have seen the thermometer rise to two hundred and twelve degrees on being plunged into fissures which exhale an aqueous vapour. Each small cone is a *fumarole*, from which a thick vapour ascends to the height of from twenty-two to thirty-two feet. In many of them a subterraneous noise is heard, which appears to announce the proximity of a fluid in ebullition.

"In the midst of the ovens, six large masses, elevated, from three hundred to one thousand six hundred feet each, above the old level of the plains, sprung up from a chasm, of which the direction is from N. N. E. to S. S. W. This is the phenomenon of the Monte Nuovo of Naples, several times repeated in a range of volcanic hills. The most elevated of these enormous masses, which remind us of the Puys in Auvergne, is the great volcano of Jorullo. It is continually burning, and has thrown up from its north side an immense quantity of scorified and basaltic lavas, containing fragments of primitive rocks. These great eruptions of the central volcano continued till the month of February, 1760. In the following years they became gradually less frequent.

"The Indians, frightened at the horrible noises of the new volcano, abandoned at first all the villages situated within seven or eight leagues distance of the *Playas de Jorullo*. They became gradually however accustomed to this terrific spectacle; and having returned to their cottages, they advanced towards the mountains of Aguasarco and Santa Inẽs, to admire the streams of fire discharged from an infinity of small volcanic apertures of various sizes. The roofs of the houses at Queretaro, at a distance of more than forty-eight leagues, in a straight line from the scene of explosion, were at that time covered with ashes.

"Although the subterraneous fire now appears far from violent, and the Malpays and the great volcano begin to be covered with vegetables, we nevertheless found the ambient air heated to such a degree by the action of the small ovens (hornitos) that the thermometer at a great distance above the ground, and in the shade, rose as high as one hundred and nine degrees of Fahrenheit. This fact proves, that there is no exaggeration in the account of several Indians, who affirm that for many years after the first eruption, the plains of Jorullo, even at a great distance from the ground which had been thrown up, were uninhabitable, from the excessive heat which prevailed in them.

"The traveller is still shewn, near the Cerro de Santa Inẽs, the rivers of Cuitimba and San Pedro, the limpid waters of which formerly watered the sugar-cane plantations of Don Andre Pimental. These streams disappeared in the night of the 29th September, 1759; but at a distance of six thousand five hundred feet farther west, in the tract which was the theatre of the convulsions, two rivers are now seen bursting through the argillaceous vault of the *Hornitos*, which make their appearance as warm springs, raising the thermometer to one hundred and twenty six degress of Fahrenheit.

"The Indians continue to give them the names of San Pedro and Cuitimba, because in several parts of the Malpays, great masses of water are heard to run in a direction from east to west, from the mountains of Santa Inẽs towards *l' Hacienda de la*

Presentacion. Near this habitation there is a brook which disengages sulphuretted hydrogen. It is more than twenty-three feet in breadth, and is the most abundant hydro-sulphureous water which I have ever seen.*

"The five active volcanos just noticed appear to be connected by a chain of intermediate cones running in a parallel direction, and exhibiting evident indications of a similar origin."

"Thus Orizaba is connected with Popocatepelt, by the Coffre de Perote, and with Jorullo, by the extinct volcano of Mexico, otherwise called Iztaccihualt;" the substance of which they are composed is trachyte through which the volcanic vents act.

In Guatimala and Nicaragua between Mexico and the isthmus of Darien, between 10° and 15° of north latitude, twenty-one active volcanos are enumerated; the direction of the chain is parallel with that of the Cordilleras.

South of the isthmus there are three volcanos in Pasto, three in Popayan, and five in Quito.

"The connexion of that near the town of Pasto with those of the province of Quito, was shewn in a striking manner in 1797. A thick column of smoke had proceeded ever since the month of November, 1796, from the volcano of Pasto; but to the great surprise of the inhabitants of the city of that name, the smoke suddenly disappeared on the 4th of February, 1797. This was precisely the moment, at which, sixty-five leagues farther south, the city of Riobamba, near Tunguragua, was destroyed by a tremendous earthquake.

"Between Quito and Chili only one volcano is known to occur, and this is situated in Peru."

"Nevertheless the frequent occurrence of earthquakes in the intermediate country renders it probable, that no natural separation exists between the two provinces, but that the same operations are in fact proceeding throughout the whole intermediate tract.

"It appears probable, says Humboldt, that the higher part of the kingdom of Quito, and the neighboring Cordilleras, far from

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* Mr. Poulett Scrope has given a different theory as to the formation of the volcanic mountain and hornitos of Jorullo, for which see his Considerations on volcanos or the abstract of it, in our last No.

being a groupe of distinct volcanos, constitute a single swollen mass, an immense volcanic wall, stretching from south to north, the crest of which exhibits a surface of more than six hundred square leagues. Cotopaxi, Tunguragua, Antisana, and Pichinca, are placed on this immense vault, and are to be considered rather as the different summits of one and the same volcanic mass, than as distinct mountains. The fire finds a vent sometimes from one, sometimes from another of these apertures. The obstructed craters appear to us to be extinguished volcanos; but we may presume, that, since Cotopaxi and Tunguragua have only one or two eruptions in the course of a century, the fire is not less continually active under the town of Quito, under Pichinca, and Imbaburu."

In Chili it is said there are sixteen active volcanos; their range is nearly parallel to the coast, near the summit of the middle of the Cordilleras; the lava and ashes which they discharge never extend beyond the Andes. "Only two volcanos are found among the maritime and midland mountains; one at the mouth of the river Rapel, which is small and emits only a little smoke at intervals; the other, the great volcano of Villarica distinguishable at the distance of one hundred and fifty miles, and said to be connected at its base with the Andes."

"It continues burning without intermission, but its eruptions have seldom been violent. The base is covered with forests, and its sides with a lively verdure, but its summit reaches above the line of perpetual snow.

"The most remarkable eruption of the Chilian volcanos was that of Peteroa, on the 3d of December, 1760, when the volcanic matter opened for itself a new crater, and a mountain in its vicinity experienced a rent of several miles in extent. A large portion of the mountain fell into the Lontue, and having filled its bed, gave rise to a lake in consequence of the accumulation of the water.

"Thus a line of volcanic mountains may be traced at intervals from the 5th to the 40th degree of south latitude, running nearly parallel to each other; whilst the intervening spaces exhibit, in the frequent earthquakes that occur, phenomena of an analogous kind.

"This apparent communication, or at least similarity of constitution, subsisting between the several parts of this tract, is the more remarkable, from the absence of all indications of volcanic action from the countries situated on the eastern side of the Andes, whether in Buenos Ayres, Brazil, Guyana, the coast of Venezuela, or the United States.

"It is true there exist a little to the east of the Andes three small volcanos, situated near the sources of the Caqueta, the Napo, and the Morona, but these in Humboldt's opinion, must be attributed to the lateral action of the volcanos of Colombia.

"There is one remarkable phenomenon belonging to volcanos of the new world, which, though not altogether peculiar to them, is more frequent there than among those of Europe.

"It often happens, that instead of ejections of lava proceeding from the volcano during its periods of activity, streams of boiling water mixed with mud alone are thrown out.

"It was once imagined that the mud and water were genuine products of the volcano, derived from some spot in the interior of the mountain, equally deep-seated with that from which the lava itself proceeds; but a fact recorded by Humboldt has done much to dispel this illusion.

"It seems, that with this mud are often thrown out multitudes of small fish (Pymelodes Cyclopum,) sometimes indeed in numbers sufficient to taint the air. Now as there is no doubt that these fish proceeded from the mountain itself, we must conclude, that it contains in its interior large lakes suited for the abode of these animals, and therefore in ordinary seasons out of the immediate influence of the volcanic action.

"Admitting the existence of these lakes, it is certainly most natural, to attribute the water thrown out to the bursting of one of them, and the mud to the intermixture of the water with the ashes at the same time ejected."

For the general conclusions of Humboldt, to whom we owe most of our knowledge of American volcanos, we must refer to the abstract given by Professor Daubeny from page 345 to 352.

The remarks of Prof. Daubeny and others on the causes of earthquakes and volcanos, with some of our own, must, on account of the great length of this article, be postponed to a future, probably the next number.

Art. VI.—*Review of the Principia of Newton.*

(Continued from Vol. XII, page 338.)

In a review, which has for its objects, some account of the inventions and discoveries of the greatest genius and inventor, that has ever appeared on earth, and which aims at truth, by asserting the rights due to an illustrious progenitor, in opposition to plagiaries and pretenders, it would evidently be a dereliction of its purpose, not to exhibit some of the greater and more marvellous productions of our author, however little they may be understood or appreciated by the readers of the present times.

We have now come to that which has been denominated the most noble problem, (*problema nobilissimum,*) viz. the 41st of the principia, we may add the epithet of the most universal in the whole theory of motion. It is thus enunciated in the translated work of our author.

"Supposing a centripetal force of any kind, and granting the quadrature of curvilinear figures, it is required to find as well the trajectories in which bodies will move, as the times of their motions in the trajectories found."

The form of expression here used, viz. the quadrature of curvilinear figures, would not be very intelligible to those not well versed in the history of mathematics, neither would that used in the 39th proposition, where the velocity of a falling body is proved to be as a right line, whose *power* is as the area of a certain curve; but in modern phraseology, the quadrature of curves is the integral, or fluent of an expression, involving only one variable, the function of the abscissa, into its differential, which constitutes the differential of the area; and by the *power* the ancient mathematicians meant the square or second power.

The analysis of this proposition would be impossible without the aid of the physical discoveries previously made in the principia, viz. the laws of motion, the composition and resolution of motion, the uniform and equable description of areas, and the more profound principles of the 39th and 40th propositions. We are hence led to the *precepta* or principles of the analysis, which consist in finding the angular space passed over, and the altitude or distance of the body from the centre of force, after any elapsed time. There are given the direction and initial velocity, and by the 39th proposition the altitude from which a body falling by virtue of the variable centripetal force would acquire the same velocity. This, by the same proposition, will ever be proportional to the nascent increment, fluxion, or differential of the curvelinear trajectory, (see page 336 of the last volume of the American Journal,) this nascent increment is an element, on the quantity and direction of which, together with the radius vector depends the paracentric velocity, and the generation of the area. The fluxion of the area and of the time, is therefore to be expressed in terms of those quantities, the integral of which will be the whole area, or time, corresponding to any altitude, or *vice versa*, the time being given the altitude will be given. If we put the distance of the moving body from the center of force $= x$, its distance at the commencement of the motion, $= a$, and $z = \frac{Q}{x}$, the fluxional formula of Newton, for the area corresponding to any elapsed time from the beginning, is $\frac{Q\dot{x}}{2\sqrt{ABFD - z^2}}$ where $\sqrt{ABFD}$ is an area, or as a right line expressive of the velocity as obtained in the 39th proposition. In a similar manner, the area generated in a circle, of a radius, equal to the initial distance, will be expressed by $\frac{Q \times a^2 \dot{x}}{2x^2 \sqrt{ABFD - z^2}}$, and that of the arc itself by $\frac{Q \times a, \dot{x}}{x^2 \sqrt{ABFD - z^2}}$. These are the fluxonial expressions of the quadratures of curves, and therefore easily integrated. There will result the angular space, or position of the body, and its distance from the center of force, and from this a point in the trajectory, and all its points or loci, may be expressed in terms of the radius vector, and the functions of an arc of a circle, and the curve will be algebraical, when any sector of a circle can be expressed by a finite equation, equal to the sectoreal area, generated by the initial radius vector, otherwise it will be transcendental.

The celebrated Bernouilli, so often mentioned, some twenty or thirty years after the publication of the Principia, produced what he called an analytical solution of this great problem, or more properly, he converted Newton's geometrical solution into one which was algebraical; his formula for the increment, or differential of the arc Z, the measure of the angular motion is $\dot{Z}=\frac{a^2c^2\,\dot{x}}{\sqrt{ab\,x^4-x^4\sqrt{\phi\,x}-a^2c^2x^2}}$, which is precisely the same as that of Newton, if $ab-\sqrt{\phi\,x}$ be substituted for the area ABGE, $a\,c$ for Q, and a for the radius of the circle measuring the angular motion. But this mathematician affects to consider Newton's solution as incomplete, because he had not applied it to the most important cases of a body acted on by a force varying in the inverse duplicate ratio of the distance. In this, he appears not to have recollected, or regarded the copious investigations of the direct problem of centripetal forces in the 2d and 3d sections of the Principia, and of the converse of this particular case in corol. 1, prop. 13, and the more general solutions in propositions 16 and 17. The same author, for the purpose of showing the necessity of his own solution, says, that many other curves besides the equi-angular spiral may be described by a force varying in the inverse triplicate ratio of the distance. This subject has also been fully developed, in a general manner, in the 3d corollary of the proposition now under consideration, which, on account of its profundity, and most curious results, we would gladly exhibit; but of this, a review would hardly be possible, on account of the mutiplicity of diagrams and symbols, necessary for its illustration. Though it be simply a corollary, it is susceptible of expansion to volumes, and comprehends an immense portion of the theory of motion: we can do little more than state its substance, and some of its results.

If a body be projected perpendicularly to the radius vector, and be acted on by a force varying in the inverse triplicate ratio of its distance from the center of force, the curve in which the body will move, will be determined by taking the angular motion as the sector of a conic section whose center is the center of force, and the distance equal to the distance from that center to the point of intersection of the tangent with the axis of the figure. The particular section assumed for the construction of the trajectory, will depend on the initial velocity. If this be such as would be acquired by a body falling from an infinite height, and the projection be perpendicular to the radius vector, the differential or fluxion of the trajectory becomes equal to the element of the tangental projection, and the curve is a circle. If the velocity of projection be still the same, but the direction of it be not perpendicular to the radius vector, the differential of the trajectory will have a constant ratio to the element of the motion perpendicular to the radius vector, and consequently the curve will make equal angles with the radius vector. In both cases the trajectory will make equal angles with the radius, and is therefore the equi-angular spiral, for the circle is a curve which every where makes equal angles with the radius.

If the velocity of projection be either more or less than that which would be due to an infinite height, the differentials of Newton's expressions become those of hyperbolic or elliptical sectors, and of the distance of the centers of the figures from the points of intersection of the tangent and axis. The former figure will be used when the velocity is less than that in the first cases, and the trajectory will be a spiral constantly approaching the center of force; but if the velocity be greater than that due to an infinite height, the curve by which the trajectory may be constructed, will be an ellipse, and the trajectory itself a spiral constantly receding from the center and terminating in an assymptote after an infinite number of revolutions; the degree of its approximation to the assymptote, will depend on the direction and velocity of the moving body. When the trajectory becomes the hyperbolie spiral, as under certain conditions it necessarily must, this curve having its sub-tangent a constant quantity, the centrifugal and centripetal forces will be equal, and therefore no change in the paracentric velocity will arise from the comparative effect of those causes, and the latter motion will be uniform. This principle may not appear obvious, but may be shown thus: the equation of the hyperbolic spiral is $zw=a$, where z is the radius vector, and w the angle which it makes with the axis of co-ordinates, whence w is always inversely as Z, and the centripetal or centrifugal force in circles being always as $\frac{V^2}{R}$ where V expresses the velocity in describing similar evanescent areas of circles by substituting $\frac{1}{R}$ for V, we get F : $\frac{1}{R^3}$ the centrifugal force = to the centripetal; whence no variation of the paracentric velocity in this curve can arise. Or thus, the absolute velocities in a given time, or for a given area, will be inversely as the distance, whence the formula for the centripetal or centrifugal force F : $\frac{v^2}{R}$, becomes $\frac{1}{R^3}$.

As we have before observed, the various and copious results of our author's great problem cannot be fully exhibited in our review. They have been spun out by his successors into volumes, and may be found in the writings of Keil, Bernouilli, Simpson, Maclaurin, Dawson, Matthew Stewart, and others. The last writer has afforded some very elegant geometrical propositions, illustrative of our author's work, on this and other propositions of the Principia. There is, however, one corollary of too much importance to be passed over, especially as it relates to the subject of the subsequent section, viz. the motion of the apsides. The apsis of a trajectory, or orbit, is that point where the curve is perpendicular to the radius vector, or where the paracentric motion ceases; whenever that is the case, the motion in the curve, and that along the perpendicular to the radius vector, which constitutes the generated element of the area, are equal. This determines the apsis of the curve, which, however, in all cases may not obtain, or if it should, it may be only for a determinate number of revolutions, and after that, the body may go off ad infinitum, or be urged to the center.

Our great author, in order to show the motion of the apsides in cases most applicable to the motion of the planets, has devoted a whole section of his work to the investigation of this subject, of which we shall endeavor to give some account.

When the centripetal force is accurately in the inverse duplicate ratio of the distance, the revolving body may describe either a circle about its center, an ellipse, or other conic section about its focus. If the force be as the distance directly, it will describe either a circle, or an ellipse about its center. These are the only laws of force, by which a body can describe an ellipse accurately, or so that the curve should perpetually return into itself, without any variation of the similar and homologous parts of its orbit, or without any variation of the position in space of that distinguished point denominated the apsis. This point under the influence of such forces must be fixed. If now we suppose the force to act by laws differing from these, it is evident that the trajectory cannot be a conic section, but some other curve, the apsis of which must be a different point from that of a conic section, or it may never come to an apsis. If, for instance, as has been shown in the last problem, the force be as the cubes of the distances inversely, and the velocity of projection be perpendicular to the radius vector, and such as would be due to an infinite height, the revolving body makes always the same angle with the radius vector, and has no tendency to come to an apsis, after any number of revolutions however great, but will revolve in an equi-angular spiral, or a circle which is a limit to such spirals. On the other hand, if the force vary in a less inverse ratio than the duplicate, the revolving body will have a tendency to an apsis, or will come sooner to it than if it were accurately in that ratio, and when the force varies so far from that accuracy as to be in the direct ratio of the distance, the moving body then comes to an apsis by performing half the angular motion it otherwise would in a fixed orbit, and has, in reality, in comparison of this, four apsides. Now if we regard nothing but the mere motion or mutation of the apsides, and the orbits otherwise to be unchanged; we may consider that point changed, while the body is moving in an ellipse, and all other circumstances to remain the same. This however cannot take place, unless the orbit itself, or its plane, be changed by a revolution about its center. This compound motion of the orbit and of a body moving in that orbit, would constitute a curve in an immoveable plane; but the curve generated would not be the true curve unless the distances and relative positions of the moveable and immoveable curves were always the same. This condition being supposed, the forces necessary for the retention of a body in an orbit which is itself moveable, may be investigated, if by its compound motion it describe equal areas in equal times about a fixed point. Newton has used this principle for ascertaining the motion of the apsides in elliptical orbits not much differing from circles. Supposing the motion of the apsides to be produced by this compound motion, viz. the motion of a body moving in an ellipse, and a motion of rotation in a circle. This latter motion is additional, or subductive of the former, but the areas generated by it, if the rotatory motion be uniform will always be proportional to those in the fixed ellipsis, and with proper degrees of force, the body may revolve in this manner about a fixed point as a center. But the forces for its retention in the ellipse and circle, act according to different laws. If Q be the force in either, for the ellipse we have Q : $\frac{1}{d^2}$, *d* being the distance ; in the circle we must have Q : $\frac{1}{d^3}$, for, as has been shown in the last sections, a body to preserve an equality of areas at different distances, moving in a circle or equi-angular spiral must have the central force acting on it in that ratio.

Hence we conclude, that if a body by a central force describe a curve, it will describe the same curve moveable about the center of forces by compounding with the proper force in the immeveable orbit, another force, which is in the inverse triplicate ratio of the distance. If this force be added, the motion of the curve and that of the body tend the same way. If it be substracted, they will be directed towards contrary parts. In order to investigate the motion of the orbit, or of the apsides, in virtue of the new or extrinsical force, Newton assumes a moveable elliptical orbit, and calculates the ratio of the forces necessary for the movement of a body in such an orbit, and the angular motions in the fixed and moveable orbits. The formulas of the forces in terms of the angular motion being obtained, the angular motion of the orbit may be found, and *vice versa.* This angular motion is that of an ellipse, whose retaining force varies in the inverse duplicate ratio of the distance, together with that of a circle, whose force varies in the inverse triplicate ratio of the distance. The angular motion of other orbits whose forces vary in other ratios, may be deduced from the formula for that of the ellipse, if we suppose those orbits not to vary much in their radii vectores from circles. For circles can be described by forces varying according to any law, and trajectories varying little from them in distance, are little affected by variations of force depending on the distance, compared with the extrinsical force which produces a revolution of the orbits themselves. If now the motion of the body in the curve be similar to that of a body in a moveable ellipsis, the force by which it is retained in its trajectory must be analogous to the force by which a body is retained in such an ellipse : for it is by analogous forces only, or such as consist of corresponding proportional parts, that similar curves are described. The analogous forces, as expressed by the formula, being compared, it will be seen what part of the force retaining the body in the curve, is in excess, or defect of that which is necessary to retain a body in an immoveable ellipse, and consequently what angular motion in *consequentia* or *antecedentia* will be given to the apsides.

If there be a force, which is in any given ratio of the distance, and its index be denoted by $n-3$, and M be to N in the ratio of the angular motion of the body in the moveable, to that in the fixed ellipse, we derive this proportion M : N :: 1 : $\sqrt{n}$, or the angular motion in an ellipse, moveable about the center of force, is to the angular motion in the same ellipse at rest, as one to the square root of a number, which exceeds by 3 the index of the power, whose ratio the force follows. Therefore, from the force given, the angular motion of the orbit, or apsides will be given, and *vice versa*, the motion of the apsides being given, the law of the centripetal force may be found. The results, though not accurate by this method, or such as can much improve practical astronomy, are sufficient for physical purposes, and the verification of the Newtonian system of philosophy, for which they were intended. They are, moreover, curious and instructive, as more principles are employed than perhaps in any other isolated problems of our celebrated author. His deductions, however, embrace only the effects produced by forces in the direction of the radius vector, which is a general problem in Physico-Mathematics. The application of this to the lunar orbit will be found to produce not more than one half of the real motion of the moon's apsis, of which deficiency our author was fully aware, the other part of the motion is the effect of the sun's force acting perpendicularly to the radius vector; Mr. Clairaut was the first mathematician who instituted a rigid analysis of the moon's motion. His calculation of the motion of the apsides brought out results very different from their true motion. Not suspecting that he had made any material mistake, he began to question the accuracy of Newton's laws of gravitation. Similar doubts on this point had also been entertained by Leonard Euler, the greatest mathematician at that time in Europe. Mr. Clairaut, however, revised his calculations and detected a mistake, which, when corrected, brought out the motion of the apsides, from Newton's principles of gravity and motion, agreeing precisely with their real motion, as ascertained by observation, and established the Newtonian Celestial physics on the most immoveable basis. Euler, also, after very elaborate calculations, confirmed those of Clairaut; his words are, " I have renewed my inquiries on this affair, (the motion of the apogee), and after most tedious calculations, I have at length found to my satisfaction, that Mr. Clairaut was in the right, and that this theory is entirely sufficient to explain the motion of the apogee of the moon. As this inquiry is of the greatest importance and difficulty, and as those who have hitherto pretended to have proved this nice agreement of the theory with the truth, have been much deceived : it is to Mr. Clairaut, that we are obliged for this important discovery, which gives quite a new lustre to the theory of the great Newton, and it is but now that we can expect good astronomical tables of the moon." The anticipated improvements in astronomy deducible from our author's philosophy, have been realized to an astonishing extent, principally by the researches of Euler, and Laplace. The most minute irregularities in the motions of the moon and other planets, which observations could never detect, are now like truth in the abstract mathematics, derived directly by calculation, from their physical causes. Newton's philosophy could have no higher evidence of its truth, than the exact coincidence of these mathematical results in innumerable complicated actions, with the real motions of the celestial bodies. The practical utility of these great refinements in astronomy, is now well known, and explained in navigation, geography, and other useful applications.

To pursue inquiries through the different corollaries of this great problem of the motion of the apsides, would lead us into a field of speculations too extensive for our object. It may be proper, however, to state, summarily, a few of the deductions not less curious than important in the theory of orbicular and trajectory motion.

1. The species of the curve which the moving body will describe, depends principally on the law or variation of the central force, except the circle, which may be described by an uniform force of any kind, it having no variation of curvature will want no variation of force, with which it is always commensurate.

2. To revolve in an accurately immoveable ellipse, the force being in the focus, its variation must be according to the law of the inverse duplicate ratio of the distance, and if the force be in the centre, it must vary directly as the distance from it. In the first case, the body will come to an apsis in a semi-revolution, or to the same apsis in an entire revolution

of 360°. In the latter case, it will come four times to an apsis, in an entire revolution of 360°.

3. Again, if the force vary as the cubes of the distances inversely, the trajectory will every where make such angles with the radius vector, as will never come to an apsis.

4. If the force be not such as is necessary for the description of an accurate ellipsis, it is evident that the body must describe some other curve, whose apsides will be in different places from those of an immoveable ellipse. If that force be in a greater inverse ratio than the inverse duplicate ratio of the distance, the trajectory then verges towards such an one as is produced by forces in the inverse triplicate ratio of the distance, which prevents the body from coming to an apsis as soon as it otherwise would, consequently the motion of the apsides is progressive.

5. If the force vary in a less inverse ratio of the distance than the duplicate, it then verges to the case where it is directly as the distance, and comes to an apsis in moving only 90°, or over half the angle of revolution necessary for a fixed orbit, the motion of the apsides is then regressive.

6. By these laws of force variously compounded, bodies may move so as perpetually to form apsides, or so as to have none, or to have a determinate number of them, and then to fly off *ad infinitum.* Some of these cases it would not be amiss to state.

1. When the centripetal force is as any power of the distance directly, or less than the first power thereof inversely, the orbit will always have an higher and lower *apsis*, beyond which the body cannot ascend or descend.

2. If p, the velocity in the trajectory compared with that of a circle be as $p : 1$—and n be the index of the power of the force, according to the distance, then when the centripetal force is as any power of the distance, (whole or broken) betwixt the first and third, the orbit will have two apsides, if p be less than $\sqrt{-\frac{2}{n+1}}$, but otherwise only one; in which last case the body, after it has passed its apsis, will continue to recede from the centre *in infinitum.*

3. When the centripetal force is inversely as any power greater than the third, the orbit can, at most have but one apsis; but in some cases it will have none at all; it may go off *ad infinitum*, or it may revolve in a spiral, approaching the

centre, but never coming nearer to it than a certain distance, or to a circle which is the limit of the spiral motion.

The philosophical discoveries of Newton, which we have already attempted to review, and the more numerous and profound investigations contained in the subsequent portion of the Principia, could not, it is evident, be made or generally demonstrated without a perfect knowledge of that science or art of analysis denominated fluxions, or the differential calculus. This branch of the mathematics is grounded on the relations which subsist between the increments of variable quantities considered as evanescent, and the quantities themselves; but this principle which constitutes the *rationale* or metaphysique of the science, of itself would afford no advantage unless we were able to determine those relations, and it never could be estimated as a science unless we were in possession of general rules, or a general method by which those relations might be calculated in all cases, to which the principles were applicable, or in the language of our author, "*Methodus quæ extendit se citra molestum ullum calculum, in terminis surdis æque ac integris procedens.*" Fluxional principles had before Newton been used by Farmat, Roberval, Napier, Barrow, Wallis, Mercator, Gregory, and others, for the solution of particular problems of drawing tangents, but in a partial degree, and limited to such quantities as could be expressed by rational functions and of course affording very simple expressions of the ratios of the nascent increments. No rules or system of rules which extend generally to the solution of all kinds of difficult problems were thought of, or if so, were supposed susceptible of discovery, unless the arithmetic of infinites of Wallis may border on systemization, but the grand discovery, the clue which should lay open all the intricate recesses of the Labyrinth, was yet to be made. It was the development of any function of a binomial, whether radical, fractional, or any how involved, so that the second term of that development, which is the nascent increment, fluxion, or differential of the function, may be correctly calculated. That clue was furnished by Newton by his methods of series interwoven with his fluxional calculus, and this long before any other person had laid claim to this invention ;* he therefore must be considered as the first inventor of a science

* Vide Lemma 2d of the 2d book of the Principia, and analysis *per equationes terminis infinitis*, by Stewart.

which has been the prolific source, or rather instrument of the greatest discoveries in mathematics and natural philosophy.

Thus much appears consistent with our views of asserting the claims of our great author, both physical and mathematical, in opposition to those writers of modern times, who have endeavoured to deprive him of some of the honours of his inventions, especially in the mathematics. Let any one read all his writings on algebra, fluxions, and the geometry of curve lines, and he will hesitate to decide in which he was the greatest, in mathematics or philosophy. Mr. Maclaurin was of opinion, that his genius shone most transcendently in optics, though the Principia, on account of the dignity of its subjects, has excited the greatest admiration. It is certain, that our author touched no subject, but with that masterly and almost supernatural power, which was peculiar to him. The style of his writings is indicative of his mind, always clear, but concise, and so much so, that one would suppose he was speaking to none but his equals, who were masters of all the principles of which he was possessed. Hence the advantage of comments and elucidations, and in our opinion, of a review of his works, which, however imperfectly executed, would at least lay open the fountain, from which almost all our boasted discoveries in philosophy are derived.

ART. VII.—*On the causes of the inadequate protection afforded by Lightning Rods, in some cases, and the means of insuring their perfect competency: also, a refutation of the prevalent idea, that Metals are peculiarly attractive of Electricity;* by R. HARE, M. D., *Professor of Chemistry in the University of Pennsylvania.*

IN some of our American newspapers, a letter has been republished from the London Times, calculated, as I conceive, most perniciously to lessen the confidence of the public in metallic conductors, as a means of protection against lightning. In common with many other persons, the author of the letter appears to suppose, that metals are peculiarly attractive of electricity; and infers that, when a metallic rod is attached to a house, or ship, a discharge of electric fluid may be induced from a cloud, which otherwise would not have been sufficiently near to endanger the premises. Nothing in my opinion can be more erroneous than this notion. The truth is, that the earth and the thunder clouds being in opposite electrical states, the electric fluid tends to pass from one to the other, in order to restore the equilibrium. The atmosphere being a non-conductor, through which a discharge cannot be accomplished without a forcible displacement of air, any solid body rising above the earth's surface, which may be more capable than the air, of transmitting electricity, is made the medium of communication. Metals being pre-eminently capable of acting as conductors, the transmision of electricity is made through them, with proportionably greater facility. Yet they do not attract it more than other substances, similarly electrified. A glass, or wooden ball, is as readily attracted, by the excited conductor of an electrial machine, as a ball of metal; and as much more, than a metallic point, as the superficies of the ball, may be greater than that of the point.

Nothing, to me, appears more unfounded than an idea, lately suggested, that the attraction between a ship, and a thunder cloud, can be increased, by the presence of a pointed metallic rod surmounting the main-mast.

If houses, or vessels, have been struck with lightning, while provided with conductors, it is, in my opinion, owing to the conductors being improperly constructed; or having no adequate connexion with the earth. The power of any body to receive an electric discharge, is dependant on the conducting power of the medium in which it terminates, no less than upon its own. A metallic rod, held by a glass handle, or entering a mass of pounded glass, or dry sand, would not be more efficacious, as a conductor, than a glass rod similarly situated. If terminated by an imperfect conductor, as for instance by earth or water, its power is reduced in proportion to the imperfection of the medium thus bounding it. This influence of the media, in which conductors terminate, has not been sufficiently insisted upon in treatises on electricity. I should not consider a metallic rod, terminating, without any enlargement of surface, in the water or the earth, as an adequate protection against lightning; but were such conductors to terminate in metallic sheets, buried in the earth or immersed in the sea, or *by a connexion duly made with the iron pipes, with which our city is watered, or the copper with which ships are generally sheathed*, I should have the most perfect confidence in their competency.

It is not only important that the points of contact, between the metallic mass, employed to afford lightning an adequate passage, and the earth or water, in which it terminates, should be so multiplied as to compensate for the inferior conducting power of the earth or water; but it is also necessary that the conducting rod be as continuous as possible. When conductors are to be stationary, as when applied to buildings, they should consist of pieces screwed together, or preferably, joined by solder, as well as by screwing. Where flexibility is requisite, the joints should be neatly made, like those of the irons in fall top carriages; and should be rivetted so as to ensure a close contact at the junctures.

In all cases, the ordinary, but important precaution of having the rod to terminate above, in a fine clean point, should be attended to. Where platina tips cannot be had, multiplying the points by splitting the rod into a ramification of pointed wires, may compensate for the diminution of conducting power, arising from rust.

The efficacy of the point or points, is, however, dependant on the continuity of the conductor of which I have already spoken: since it is well known, that if a pointed rod be cut into parts, so as to produce intervals, bounded by blunt terminations, its efficacy will not be much greater than if it had no point; because the fluid will, in that case, pass in sparks, instead of being transmitted in a current. It is on this account that I object to chains, or rods joined by loops or hooks and eyes. The error of supposing that a metallic rod must be more capable of attracting electricity injuriously, because of its known wonderful power in transmitting it, will be evident, when it is understood that the only difference between metals and other bodies, arises from the superior power of transmission. Hence, when by a defective communication with the earth or sea, the efficacy of the metal, as a conductor, is diminished, or destroyed, its influence over a charged cloud is proportionably lessened. It follows, therefore, that so far as it acts, its action must be beneficial, unless its lower termination should, by an inconceivable degree of ignorance or inattention, be so situated, as to render it more easy for the electrical fluid to leave the rod, and pass through a portion of the house or vessel, than to proceed, by means of the rod, into the earth or sea.

Thus, Richman was killed by a conductor which he employed to receive electricity from the clouds, and to convey it to an electrometer, necessarily insulated: under these circumstances, the head of the pofessor being about a foot from the conductor, he became a part of the channel of communication with the earth. Had the apparatus been surrounded by a cage of wire, and this duly connected with a metallic rod, soldered to a sheet of metal buried in the earth, Richman might have made his observations with perfect security. That, with due precaution, experiments, analogous to his, are not productive of injury to the operator, is rendered evident by the subjoined quotation from Singer's Electricity.

I must premise, that the apparatus, by means of which the phenomena alluded to were produced, consisted of a wire a mile long, supported and insulated, upon very high poles, and terminating in the house of the electrician, Andrew Crosse, Esq.

"The approach of a charged cloud, produces sometimes positive, and at others negative signs, at first: but, whatever be the original character, the effect gradually increases to a certain extent, then decreases, and disappears, and is followed by the appearance of the opposite signs, which gradually extend beyond the former maximum, then decrease, terminate, and are again followed by the original electricity. These alternations are sometimes numerous, and are more or less rapid on different occasions, they usually increase in intensity at each repetition, and at last a full dense stream of sparks, issues from the atmospherical conductor to the receiving ball,* stopping at intervals, but returning with redoubled force. In this state a strong current of air proceeds from the wire and its connected apparatus; and none but a spectator can conceive the awful, though sublime, effect, of such phenomena. At every flash of lightning, an explosive stream, accompanied by a peculiar noise, passes between the balls of the apparatus, and enlightens, most brilliantly, every surrounding object, whilst these effects are heightened by the successive peals of thunder, and by the consciousness of so near an approach to its cause."

"During the display of electric power, so awful to an ordinary observer, the electrician sits quietly in front of the apparatus, conducts the lightning in any required direction, and employs it to fuse wires, decompose fluids, or fire inflam-

* That is, a ball communicating with the earth, by an adequate metallic conductor.

mable substances; and when the effects are too powerful, to attend to such experiments securely, he connects the insulated wire with the ground, and transmits the accumulated electricity with silence, and with safety."

Art. VIII.—*Remarks on the use of Piperine, with the formula for its manufacture, together with observations and experiments on the Piper Nigrum and its preparations;* by George W. Carpenter, of Philadelphia.

Since the discovery of quinine and cinchonine, by the celebrated chemists Pelletier and Caventon, vegetable chemistry, previously almost unknown as a science, has made rapid advancement; and the still further successful experiments and discoveries since made upon vegetable matter, have not only swelled the catalogue of highly important and useful materials, but have given an additional stimulus for the undertaking, and created an ardent zeal for investigation in those already engaged in researches, as well as opened a field of encouragement, in which numberless votaries have appeared. By these means, this department of science, having emerged from a stage of neglect and obscurity, has risen with unparalleled rapidity, even within the space of a few years, to its present exalted position; and the numerous advantages and useful discoveries, resulting from its rapidly improving condition, have caused it to rank as one of the most important branches of chemical science.

Every vegetable substance in the materia medica, which has yet been subjected to chemical analysis, has produced an elementary or alkaline principle, upon which the virtues and activity of the medicine entirely depend. An instance is found, even in opium, which, acting in a double capacity, both as a stimulant and sedative, has afforded two principles, corresponding with the operations of the crude material: one is stimulating, the other sedative. When administered in combination, acting like the crude substance; when separate, individually exercising the sedative or stimulating effects, as one or the other may be employed. These isolated substances possess many and great advantages over the crude materials. The activity of those particular effects, which are desired from the administration of the medicine, being concentrated, and consequently greatly increased by the separation of the inert and injurious portions, obviates almost entirely the difficulty of exhibition, as well as facilitates a more speedy and certain action on the constitution.

It is well known that many substances, in their crude state, in consequence of bulk and insolubility, cannot be administered in many stages of debility in sufficient quantity to produce the desired effect. In such instances, the alkali is well adapted to form a substitute; for being separated from the more gross, ligneous, and inert portions, it requires a comparatively small dose, and constitutes a valuable remedy in cases where the former would be rejected. Another, and no less important advantage in favour of the alkaline principles is, the uniform persistency of their strength. No one will for a moment question the many inconveniences and evils, resulting from the great uncertainty of effects and difference of activity, in most of the crude materials; and some of the most important are subject to these defects. Peruvian bark, for example, is composed of twenty-five species, and each one differing in strength. Bark, even of the same species, from a difference in adventitious circumstances,* to which it is always exposed, (although its external characters are sometimes scarcely affected, its quality is always injured) is scarcely ever found alike. I have met with bark in the preparation of quinine of the same species and of the same importation, differing twenty-five per cent. in the product of the active alkalies. The physician, therefore, would have been deceived in the strength and consequent effect of this bark, while the quinine is universally the same. For example, the quinine, produced by the inferior bark, although much less in quantity, was fully equal in quality. If the practitioner, therefore, may be so much deceived by the difference of strength of the same species, how much more would he be disappointed by those which produced but one-eighth or one twelfth the quantity—and some yield even but a trace of the principles upon which their febrifuge properties exclusively depend.

The preceding observations in support of concentrated medicines, are made in consequence of there existing, even at this period of time, some few who disapprove of vegetable alkalies, and reject their use on all occasions, by giving pre-

* See Carpenter on Cinchona, in vol. IX, of this Journal.

ference to the crude material. If their conclusions were drawn from experiment they would most certainly be entitled to credit and respect; but where a determination is made against admitted facts, without advancing new grounds drawn from argument or reason, and where new discoveries are denounced without even a single experiment or authority of any kind, I am sorry to say that such a course can be attributed only to prejudice, and should accordingly be so appreciated.

There is another class of opposers, governed by envy: this is a worse species than the former: they are, however, of little importance as to *influence*. It has ever been a grievous circumstance, that, in almost every department of science, criticism is so easy a task, that the least informed and most unintelligent will make bold opposition against the most useful and important researches, and sometimes from no other cause than that they themselves were not the authors. Their efforts are, however, overbalanced by the happy consequence, that sentiment and expression do not, in the least, alter or modify the condition of matter; and follies of this nature, therefore, so far from effecting an injury or causing the least impediment to the march of science, merely offer an exposition of error, either to be dispersed by truth, or corrected by the light of science.

The object of the present communication is, to describe a new principle recently discovered in black pepper, which has been denominated piperine, and which is proved, from careful experiments, to be a successful remedy in intermittent fevers, and has been employed with advantage in typhus fever and periodical headache; and from the respectability of the authorities given in its support, bids fair to become an important addition to the materia medica. It may be given in doses of from one to four grains. It has been employed in doses of one grain every hour, in several cases of intermittent fever, with as much success as the quinine. It is found to be a valuable adjunct to that substance, equal parts acting with more energy and success than the whole quantity of quinine.

Black pepper, in its crude state, has long been known as a valuable medicine, and is stated to be an excellent adjunct to bark, in intermittents, and the author* observes that Mr.

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* Rennie's Supplement to the Pharmacopæias of London, Edinburgh, Dublin, and Paris.

Brande must certainly be mistaken when he says, it acts only as a warm condiment, agreeable to the stomach.*

It is mentioned in Dr. Coxe's valuable dispensatory, under the article piper, that Dr. Frank, physician to her Majesty, Maria Louisa, recommends the black pepper in different species of intermittent fevers.

This had previously been used in the east, with success, after every known means had been ineffectually tried. The dose is five to ten grains, twice a day; and Dr. Ghigini reports ten cases cured by it. Dr. Frank mentions seventy patients, who came under his notice between April and June, of whom fifty-two had tertian, ten quotidian, and eight the quartan fever. Fifty-four were completely cured within a week or so, without any subsequent relapse. He dips the seed of black pepper into a mucilage of gum arabic, and subsequently into powdered colombo, to disguise it, and gives from five to eight pills twice a day. None of his patients required more than from seventy to eighty pills for a complete cure. Dr. Frank recommends to the profession to try the extract of black pepper, in intermittent fevers. This preparation was tried on nine individuals, affected with intermittent fevers of different types, in doses of four, eight, ten, or twelve grains, dissolved in water in some cases, and given in the form of pills in others, by Dr. Clock, of Trent; and the effects surpassed his warmest expectations.

From these experiments it is concluded, that the extract of pepper is not only one of the best succedaneums for the bark, but that it is even preferable to it, on several accounts.

First. It never produces disturbance in the stomach or bowels.

Second. It never fails in producing a cure.

Third. Those who were cured did not in any one instance experience a relapse.

Fourth. It produces a regular alvine discharge, as well as the excretion of urine and sweat.

Fifth. None of those who were cured, experienced that sensation of languor, so common to a state of convalescence.

The following cases, treated with piperine, are given by Dr. J. Gordoni, physician, to the hospitals of Livourne:†

* It may be observed, with deference to Mr. Brande's opinion, that there never has been a medicine yet discovered, respecting whose qualities, some diversity of opinion has not existed, and every medicine, however valuable, has met with some opposition.

† Bulletin des Sciences Medicales, Avril, 1826.

Cleonice, of Paoli, entered the hospital in the month of March, 1824, to be treated of an incipient phthisis, in combination with amenorrhæa, a treatment lightly depleting for several months produced sensible advantages; and although the disease could not be called perfectly cured, a strong indication of a speedy recovery was apparent, for the *crachats* presented a better appearance, the cough was diminished, and the plethoric habit, accompanied with a kind of melancholy, had disappeared; when, towards the end of September, of the same year, she was attacked with a violent intermittent fever, having the type of a double tertian. This disease was treated without success, by the skillful Dr. Guidotti, both by quinine in substance, and the sulphate of quinine in pills. On the 16th of October, having succeeded Dr. Guidotti in the hospitals, I found the patient much dejected and disgusted with the insufficiency of the means employed. Supposing the failure of the quinine depended upon some neglect in its administration, or that the pills were perhaps difficult of solution, I prescribed three doses of the same substance, in powder, to be taken daily. Two days after this treatment the fever stopped short, and the patient recovered a repose, which she had lost for a month. The remedy was continued for six days, which prevented a relapse, which had always been dissipated by the same remedy; but every time the use of it was suspended, the fever invariably returned. As there were not sufficient symptoms to consider it of an inflammatory nature, I determined, on the 2nd of November, to substitute for the sulphate of quinine, eight grains of piperine, to be taken in three doses, as the sulphate, and with the same precautions. The fever ceased the first day, and never returned. The piperine was continued several days after, and I assured myself of the certainty of the cure, having attended the patient from her first disease until the end of December.

Second. A man aged thirty years, at Castiglione, on the sea shore, in the beginning of December, was seized with a tertian fever, which obliged him to enter the hospital of St. Antoine, of Livourne. Dr. Nicholas Orisini, being assured that the patient had never before been afflicted with a like fever, nor ever made use of the quinine, thought proper, as a good opportunity, to employ in this case the piperine, to assure himself of its efficacy. With this view, he let the fever run out one of its intermissions, without employing any remedy, in order to be better acquainted with the nature of the disease. He then ordered a scruple of piperine, divided into six pills, to be taken in three doses, the last of these doses to be given two hours before the fever, and the two others at intervals of two hours preceding. After the administration of this remedy the paroxysm did not appear; the patient, who believed himself cured, wished to leave the hospital, notwithstanding the remonstrances of the physician, who assured him he could not calculate yet upon an entire cure. The patient soon repented not having taken counsel, for on his way to the shore, he had a fresh attack of the fever, and was obliged to return to the hospital. He again made use of the piperine, and having continued it for several days, he went out perfectly cured.

Third. Joseph Torsi, aged twenty-six years, entered the hospital of St. Antoine, the evening of the sixth of September, 1824; had been attacked six days before, with a true quotidian fever, and it was the first he had ever experienced. On the morning of the 17th, sixteen grains of piperine were ordered to be divided into eight pills, of which, four should be taken every two hours before the fit: but before the last dose was taken, the fever returned in spite of these means. The piperine was then carried to eighteen grains, to be taken in the same manner—when the fever disappeared: and the use of the remedy being continued for several days, preserved the patient entirely from all symptoms of recidivation. Dr. Orisini, who directed the treatment, was fully convinced of the perfect recovery and cure of the patient, who, having entered the hospital three months after, to be treated for peripneumonia, assured him that he had had no accession of fever since he left the hospital.

From these observations, and many others, Mr. Gordoni draws the following conclusions:—

1. That the piperine will cure intermittent fevers, in the dose of eight or even six grains.

2. That it will cure fevers which have resisted the sulphate of quinine.

Finally: That it will prevent a relapse of fever better than that substance.

M. Meli* has also successfully employed the piperine, and considers it more certain, as a remedy in intermittents, than the sulphate of quinine.

* Ainslie's Materia Indica, vol. 2. page 622.

For the following interesting communication on the use of piperine, I am indebted to Dr. J. S. Rose, of Philadelphia, who was the first to employ it in this city.

I have employed the piperine, prepared by Mr. Carpenter, in twenty cases of intermittent fevers, and am decidedly of the opinion that it will be found by all who may be disposed to try its virtues, a more certain and efficient remedy than any preparation of bark heretofore used.

I have also used it in two cases of low nervous fever or typhus. I was induced to employ it in these cases by observing, that in intermittents it did not prevent (in the first intermissions) all the stages of the paroxysm; at the time the patient expected his chill he found a gentle diaphoresis, which continued to increase for two, three, and in some cases, for four hours; on the next day, however, (of the expected return) there was nothing like diaphoresis or fever; the patient passed this period without the least inconvenience, and remained exempt from a relapse, which is not always the case after the use of quinine. These facts led me to believe, that in typhus, when we wish a stimulating diaphoretic, nothing is better adapted, not even volatile alkali, which I have proved satisfactory to myself. In this form of febrile action, when the animal powers are about to yield to the influence of disease, and the patient falls a victim to the timidity of the practitioner, I have boldly withheld all other remedies, and administered the piperine in doses of two grains every two hours, until eight grains had been taken; in one of these cases, the low, muttering delirium now began to subside, the skin became moist, and the patient, sensible of his improvement, pronounced himself better. On the following day, the same doses were administered and repeated, for three, four, or five days, when I found no fever; the strength increased, and the patient, with an inclination for food, was certainly convalescent. These two were the only cases of typhus I have treated since I became acquainted with this valuable remedy. But these alone would incline me to say, with one of our professors, "as well might we deny the power of bark in intermittents, or mercury in syphilis," as piperine in the cases alluded to. Yet I am not prepared to adopt his language fully and call it a *Panacea*.

J. S. R.

I subjoin the following important results from the use of piperine, by Dr. J. C. Rousseau, of Philadelphia, whose experience with the articles of our materia medica, entitles his observations to the highest confidence and estimation.

Dear Sir,

In compliance with your request to state my opinion upon the efficacy of the piperine in the cure of intermittent fever, I can testify, that although I have been able to administer this new article of our materia medica in few cases, it is satisfactory to inform you, that it has been successful in every one. The paroxysms left the patients on the first, and never later than the second day.

Some few remarks may with propriety be added to this succinct account, which may become instructive, and inculcate the necessity of caution in prescribing it in too large doses; the following case will illustrate this position:—

A young girl, about 12 years of age, having had a return of an intermitting fever, that had been stopped by the sulphate of quinine, was directed to take one grain of the piperine, made into a pill, with conserve of roses. She was a short time after seized with a vomiting, which was repeated to the number of seven times in the space of two hours. It then began to promote alvine evacuations to the extent of twelve or fifteen times. The fever did not return, and she was directed to continue one grain of the medicine night and morning. It invariably produced alvine discharges in an unusual quantity.

In another case, a subject of about forty: it produced a radical cure in the dose of three grains, taken every twenty-four hours, and continued for some days after; and it is so much the more remarkable, as this patient had taken the sulphate of quinine for some days, in the quantity of thirty grains in every twenty-four hours, as he informed me, remarking at the same time, that during the use of it, he was under a most violent and painful state of excitement.

I can state with confidence, that this preparation of the black pepper, may be as useful and beneficial, as the like preparation of the Peruvian Bark, and I entertain no doubt of the probability of obtaining similar products, from all the other peppers, having been for many years, in the habit of administering the black and red peppers, with decided success, in the cure of intermittent fevers. Yours, &c.

J. C. Rousseau, M. D.

Geo. W. C.

I have just received the following valuable illustration of the effect of piperine, from my friend Dr. J. R. Black, of Philadelphia, which is an additional strong testimony of the success of this medicine, in the cure of intermittent fevers.

Mr. S. aged about forty years, during the first part of last month, applied to me, with a severe quotidian fever, attended with rejections from the stomach, and with violent pain, and great determination of blood to the head, during the hot stage, with cold feet and slight delirium.

The case was treated with the lancet, emetics and purges, which on the third day changed its type to the tertian. On the day of intermission, sul. quinine was administered, which was often rejected, while it always increased the patient's nauseau and head ache. Piperine was substituted in doses of one grain every hour, to the number of ten a day. The paroxysms immediately ceased, and the patient was in a few days discharged, radically cured. J. R. B.

Numerous other cases might be quoted in which this medicine has been employed, with the like happy results; but I think sufficient has been advanced, to satisfy the most sceptical, of its active properties.

Alcohol and sulphuric æther are the best menstrua, for the active properties of the pepper, which very soon impart its acrimony to these fluids. Mr. Brande gives alcohol and water; I am surprised that Mr. Brande should have omitted æther, since it is the most powerful solvent, and particularly that he should quote water, since it requires five hundred and fifty pints to extract the sapidity of one lb. of pepper. Water appears to be the best solvent for the coloring matter, for after pepper has been exhausted of its acrimony, by æther and alcohol, water will make a dark solution, which on evaporation, produces an extract exhibiting little of the pungency of pepper.

The piperine, employed in the above cases, I prepared according to the following formula.

Digest one pound of coarsely powdered black pepper, in one gallon of alcohol, for ten days, distil off one half of the alcohol in a water bath, add by degrees, diluted muriatic acid, to hold in solution the piperine, then add water sufficient to precipitate the resin, and separate the oil, a muriate of piperine remains in solution, concentrate this solution by evaporation, and add pure potass to decompose it, and neutralise the acid, when the piperine, in consequence of the diluted state of the alcohol, and the absence of the muriatic acid, will be deposited in yellowish transparent crystals. The crystals may be obtained perfectly colorless, by observing great care in separating the oil and resin, but as there is no disadvantage in the color, the additional trouble and expense would not be compensated. The piperine, in a colorless state, is insipid and inodorous; but united with as much resin as enters into its crystallization, its taste is extremely powerful, possessing in an intense degree, all the heat and acrimony of the pepper, with considerable of its odour, and I think is a more active preparation than the former, it was in this form exhibited in the treatment of the cases above described. I have obtained larger crystals, by employing sulphuric æther as a menstruum, instead of alcohol.

The crystals of piperine are transparent, of a straw color, and assume the tetrahedral prismatic form, with oblique summits; I have obtained them larger than the ordinary crystals of sulphat of magnesia.

Extract of Black Pepper.

Digest eight ounces of black pepper coarsely ground, in four pints of diluted alcohol, for four days, occasionally submitting it to a temperature near ebullition in a water bath, filter and evaporate to the consistence of an extract. This is found also to be an active remedy in intermittent, in doses of two or three grains. In a soft state it has proved very convenient to give consistency to peperine or quinine for the formation of pills, while at the same time it increases their activity, particularly the latter; it is certainly preferable to conserve of roses, or gum arabic, which enlarge the pill without increasing the effect.

The extract of pepper in every formula I have seen, is directed to be prepared with water. This forms a much less active preparation and possesses several inconveniences, to which the above is not subject.

I have employed the white and black peppers in the above preparations, and although it is stated that the white pepper is milder than the black, I have found it to yield more piperine and an extract of much more acrimony and activity, and to contain much less coloring matter.

The constituent principles of pepper, are peperine, oil, resin, extract, coloring and fecular matters.

The above preparations, may be procured from Charles Marshall, Druggist, 221 Market-street, Philadelphia.

Art. IX.—*On the Character and Origin of the Low Country of North Carolina; by* Elisha Mitchell, *Professor of Chemistry, Mineralogy, and Geology, in the University of North Carolina.*

TO PROFESSOR SILLIMAN.

Dear Sir—I was a good deal surprised on looking over the last number of the Amer. Journal, to find an intimate agreement betwixt the conjectures of the author of a recent work on volcanos, (with an abstract of which you have favored us) and some conclusions which seemed to be forcing themselves upon me whilst engaged in examining the low country of North Carolina. I beg leave to quote the following passage from his letter to yourself:—

"May I take the liberty of hinting a few observations connected with this subject, to which if the attention of some of your numerous geological friends and correspondents were directed, it must, I conceive, elicit some very important information. The volcanic force seems to have developed itself very rarely, if at all under its most usual form, on the eastern side of the great longitudinal axis of America, whether north or south. But this fact would lead to the supposition, that the *general* subterraneous force of expansion must have exerted itself the more conspicuously, in this direction under its other mode, viz. the elevation *en masse*, of solid strata. Is not this view corroborated by observations? Does not the ocean seem to retreat more rapidly than can be explained by the accumulative action of the Gulf Stream on its shores?"

My views were, in part, exhibited in a communication made to our board of Agriculture, in January last, but as there is a call for information respecting the appearances presented by the Atlantic coast of the United States, I may be excused for entering into the subject somewhat more in detail, than could with propriety be done at that time. As there appears to be, even amongst geologists, some degree of mistake and misapprehension about the constitution of what is commonly denominated the alluvial district of our country, at least of that part of it which lies within the limits of this State, I have thought it necessary to state a few facts respecting it, such as must have direct and positive influence upon our opinions, in regard to the time and mode of its formation. The remarks which follow, are thrown into the form of proofs and illustrations of a few propositions; chiefly for the sake of perspicuity, and convenience to myself, and not because I suppose the truth of these propositions to be fully established, and placed beyond the reach of controversy. Most of our conclusions, in the science of geology, are founded on probable arguments of greater or less force. It is proper for me to remark, that by the expression "low country," I mean especially the low country of North Carolina, to which my observations have been confined.

Of the composition and constitution of the low country.

1. The low country of North Carolina is made up of strata of clay and sand, alternating with and resting upon each other, so as to present an endless variety in regard to the extent, thickness, composition, and order of succession, of the different beds. It is possible that a more extended and careful examination will detect an unsuspected degree of order and regularity in the midst of the chaos that first presents itself to the observer. At present, individual strata appear to be of limited extent, and of very variable composition and thickness, so that the sides of two wells, sunk at a short distance from each other, present but few points of resemblance. In general the clay predominates. In many places it is very fine, and free from any admixture of sand; so fine that the streams which flow pretty rapidly over it make little or no impression upon it; and a person viewing them at a distance, would suppose their beds to be a mass of solid rock. There is a remarkable instance of this kind in the upper part of Bladen county. Pieces of clay that have been broken off, remain unchanged apparently for years. They look like masses of stone, and we are surprised to find on taking them up, that they can be cut with the greatest ease. Even in the deepest of the sand hills, a considerable admixture of clay is found in digging a short distance. It is carried down by the rains, and leaving the sand by itself upon the surface, makes the country appear more sandy and sterile than it really is.

Water worn pebbles, (quartz exclusively,) from four or five inches in diameter down to the size of common grains of sand are abundant along the upper border of this district; they diminish in size as we recede from the border, and finally, as I believe, disappear altogether in the neighborhood of the ocean; though they may be found in some situations. The clay contains masses of iron pyrites, imbedded in it, which are converted into copperas by exposure to the air. There are also quantities of bog iron ore—the kidney shaped masses of ochre, mentioned by Maclure, lignite and wood, of which the original particles have been replaced by silex. These, along with the limestone marl and shells, constitute the minerals of the district.

2. The upper border of the alluvial is very irregular. Maclure draws the line of separation between it and the upper country, "a little to the westward of Halifax, Smithfield, Averysborough, and Parkersford, on Pedee river, in North Carolina;" and for communicating a general idea of the boundaries of this formation, it is probable that a better designation of them could not be given. It is, nevertheless, certain, that many thousands of acres of sand lie on the north western, and that there are a great many fixed rocks on the southeastern side of this line. The latter occur in the bed of the Neuse, more than twenty miles southeast of Smithfield. It would appear that the sand once covered *the whole country* much higher up than it does now, but that it has been removed in the neighborhood of the streams, so that we have a broad zone extending quite across the state, exhibiting sand, clay, and water worn pebbles, upon the high grounds, completely covering up the rock formations; whilst in the neighborhood of the streams, there is a soil formed from rocks that have undergone decomposition in their original beds. The width of this zone is from twenty to forty or fifty miles. It is important to remark, that the hills covered by the sand and pebbles of the alluvial, frequently attain an elevation of three or four hundred, and I think some of them are five or six hundred feet, above the level of the sea. There are whole counties whose surface must be two hundred feet above the same level. The pebbles, found at the greatest heights, are of the size commonly used in paving, and the quantities collected in some situations are immense.

3. As we approach the sea, we fall in with marine organic remains, at the distance of from sixty to eighty miles from it. They are found in greatest abundance, along the banks of the largest rivers, where a high perpendicular bluff presents us with a section of the strata; but they are occasionally met with in places remote from the rivers, where an ex-

cavation is made. When a well is dug, a bed of shells is sometimes struck. The natural well in Duplin is ten miles from any large river. It has been found by the sinking of a cylinder of earth about ninety feet in diameter, in the midst of the flat piney woods, where there was nothing at the surface to create a suspicion that any thing besides clay and sand would be found below. The covering of sand is here about five feet in thickness, and is succeeded by a layer of shells, resting upon a bed of marl of unknown depth.

The shells are sometimes intermixed with, and imbedded, in large quantities of clay and sand, and sometimes constitute nearly the whole stratum. They are in a state of decay; many of the smaller ones, especially, are easily crumbled between the fingers. Such as are thick and heavy retain their firmness.

4. In the southern and south eastern part of the State, there are large bodies of rocks, sometimes made up entirely of shells, sometimes containing pebbles imbedded, constituting a siliceo-calcareous conglomerate or pudding stone, and sometimes presenting only the siliceous casts of shells, with a small portion of lime. These rocks are older than the remains spoken of in the last article. They are generally covered up by the clay and sand, so that it is difficult to reach them for the purposes of observation. They are well exhibited with the more recent shells resting upon them, about the town of Wilmington. Where they have not been covered by the clay and sand, but left to form by their decomposition, a soil of their own, it is wonderfully fertile. Rocky point on the north east branch of the Cape Fear, is an instance and the only one that I have examined. They appear to be the exuviae of races of animals bearing little resemblance to those now inhabiting the waters of North Carolina. They, however stand in need, and are worthy of a more minute and careful examination, than it has been in my power to give them.

Of the mode in which the low country has been formed.

1. *The low country has not been produced by the action of causes that are still in operation.*—When our ancestors landed on these shores, they were struck with the peculiarity of their appearance, and observing that they were made up of strata of sand and clay that had evidently been deposited from water, and that contained marine organic remains in

great abundance, they inferred, that they had been gained from the ocean. The gulf stream being a peculiar feature in the physical geography of the western world, and passing along, at the distance of seventy or eighty miles from the coast—it was *conjectured*, apparently from the circumstance of proximity alone, to be the cause of the peculiar aspect of our shores, and the agent by which the low country had been created. Philosophers acquiesced in the popular theory, without ever troubling themselves to enquire whether it was warranted by facts, and could be supported by argument. Its correctness is tacitly admitted by Mr. Scrope, in his letter to the Editor of the Journal. "Does not the ocean seem to retreat more rapidly than can be explained, by the accumulative action of the gulf stream upon its shores?"

We have no *evidence* whatever, that the gulf stream has the effect of accumulating sand and gravel on our coast, and least of all is there any probability that it is piling them up, in situations elevated above the level of the ocean. The waters of the West Indian seas are described as so clear and transparent, that the vessels which navigate them seem to float in the air, and the mariner can discern fish and coral at sixty fathoms below the surface. The waters of the gulf stream are of a deeper blue than the rest of the ocean, a circumstance which seems to prove at least, that they are not turbid. The rate of the current is from one to three miles an hour, and with only this velocity, its propelling force must be feeble—hardly adequate to the transportation of sand and gravel. And even if we suppose these substances to be brought along by it from the gulf of Mexico, *it can only strew them over the bottom of the sea*—it can never elevate them above its surface.

It will perhaps be said, that the stream brings along the materials and deposits them, and they are afterwards thrown up by the waves. But we are altogether destitute of *evidence* that the waves have any tendency to the production of such an effect. Our theoretical views of the nature and mode of their action would lead to the conclusion, that they would demolish and disperse existing sand-banks rather than pile up new ones—and the former rather than the latter has in fact been their effect, at least of late years, along the coast of North Carolina. A new inlet was opened, not long since, at the mouth of the Cape Fear river. It is well known that the island which was then formed is gradually wasting away.

The fortifications built during the last war, on the banks at the mouth of Beaufort harbor, have been undermined and destroyed. There may be a contrary process in a few cases—thus, the wasting of the island at the mouth of the Cape Fear, is said to be accompanied by a corresponding extension of another, and to an effect of this kind I believe the action of the waves will be found to be confined.

It is acknowledged, that to a person who casts his eye over a map of the United States, and sees the long chain of sandy islands that lines our coast, the idea is apt to be suggested that they have been thrown up by the waves, and it is possible, but not proved, that this may be the case. But it will not follow that because the waves are adequate to the erection of a low sand-bank, they can throw up a body of clay and sand an hundred miles in breadth, two, three, and four hundred feet in thickness, and having its upper surface elevated nearly the same number of feet above the greatest height at which the waves are ever known to roll. Is it within the memory of man that a sand bank has ever been formed upon our coast that is not covered, if not by the highest spring tides, at least during every considerable storm? Indeed, if any person who is travelling through the country, will notice his elevation above the bed of the Cape Fear, as he crosses Clarendon bridge at Fayetteville,* and how much he has to ascend to gain the summit of Hay Mount, and the general level of the sandy country on the west side of the town, and recollect that he is one hundred miles in a direct line from the sea, he will acknowledge that of all the theories that have been invented, to account for the formation of the low country, that which attributes it to the action of the gulf stream, such as it now is, and to such waves as now break upon the Atlantic coast, though at first sight, appearing to be the most simple and rational, is in truth the wildest and least capable of defence.

Though the considerations that have been already offered seem to be sufficient to establish the truth of our proposition, "that the low country has not been produced by the action of causes that are still in operation," it will be still further illustrated by the remarks that are to follow. I proceed therefore to observe that—

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* I have selected this place in preference to any other, because it is in the heart of the alluvial—or the great northern and southern road, and the thickness and elevation of the strata are well exhibited in its neighborhood.

2. *The low country has not been produced by a gradual encroachment of the land upon the sea, but became dry land, throughout its whole extent, or nearly its whole extent, at one time.*

The human mind is very averse to admitting amongst the causes of the phenomena it would explain, such as it has never witnessed the action of; and rather prefers the supposition, that the known causes which are now confessedly inadequate to the effect, are, at some times, or have been on some former occasion, so magnified and enlarged, as to acquire the requisite degree of efficiency. Thus, finding the gulf stream and the waves, such as we now observe them, inadequate to the creation of the low country, we are ready to conceive of some condition of the Antediluvian ocean, when they operated with far greater energy, and when they threw up this district as easily as they now form the low sandy islands that are covered at every tide—that during this state of things, the land encroached continually upon the sea, till the low country, such as we now behold it, was the final result.

If, instead of the strata of which this district is composed, we met with a totally irregular and confused collection of heaps of *sand*, this account of the matter would have more plausibility. The tendency of the irregular action of the waves, beating upon the coast, would be to form such a collection, and not those alternate layers of *clay* and sand, which we actually find. But the extension of the argument, that might be drawn from this source, is rendered altogether unnecessary, by the appearance of marine organic remains. This is quite decisive of the point, that the low country has not been gradually thrown up by the waves, during either the present or any former condition of the ocean.

It may be doubted whether Bergman was aware of the strict and philosophical accuracy of his language, and whether he did not consider himself as describing them by an elegant metaphor, when he denominated the shells that lie imbedded in the strata of the globe, the *medals of creation.* But, that this is their real character, that they furnish us with the only clue that can guide us in our attempts to unravel the ancient history of the earth, and the data from which we are to estimate the number, magnitude, and durations of the revolutions it has undergone, is becoming more and more evident, from day to day. It is by means of their organic remains, that the geology of other countries has been established on firm foundations, and it is to the same objects, that we must apply ourselves, if we would give precision and accuracy to that of our own. Hitherto, they appear to have been observed in a very general manner, if not altogether neglected. And yet, they offer a rich harvest of discovery, to the individual, who has the requisite skill and leisure to gather it. The person who, with a good knowledge of the conchology of our waters, should pass through the alluvial district, and examine its marine organic remains, would soon educe light from darkness. The shells are fragile from decay, but so far as their forms are concerned, often in a state of perfect preservation, and they may be had to any amount. They have withal, a few characters, which must strike the most casual observer, and these are all that are necessary for our present argument.

Shells that are tossed by the waves, are soon ground to a fine powder, or at least worn smooth and deprived of their sharp processes and projections. Every person who has been upon the sea beach must have observed this.

But the shells of the low country present no such marks of attrition. I should not be safe in the assertion that I have never seen a water worn shell amongst our marine remains; I have occasionally picked them up—especially in the beds of branches and gullies, where the water and sand were continually passing over them, but they are exceedingly rare. The great body of the shells offer by their appearance, conclusive evidence that they have never been tossed upon the beach. They still preserve in perfection, their minutest furrows and most tender and delicate processes. I have small bivalve shells, of which the two parts still cohere, though it requires the application of but a gentle force to separate them.

That the low country has not been *gradually* formed is further proved, by the fact, that the shells are every where of the same age. They belong to the same genera and species, with such variations only as are common in the living animals in neighboring bays and harbors, and, *in many cases*, to the genera and species now inhabiting the Atlantic coast. How far the agreement between them and the living races will be found to extend, I cannot say—the subject stands in great need of investigation, but it will probably be found to be pretty intricate. It is however to be remembered, that the eye of an experienced naturalist, will sometimes detect specific distinctions, where to one whose opportunities for observation had been less ample, there will appear to be a very exact resemblance.

That the shells are every where in the same state of decay, in places remote from each other, at a distance from and contiguous to the sea, is a matter of no uncertainty. If a person be presented with parcels from the upper part of Bladen county, from the bank of the northeast at Wilmington, seventy miles nearer to the sea, from the sides of the natural well in Duplin, and the banks of Fishing creek near Infield, and of the Meherrin at Murfriesborough, he will be unable to tell, except from the color and consistency of the sand and clay that is intermixed with them, from which locality they came.

All these appearances are totally at variance with the theory which attributes the low country to the gradual accretions of its shores. Were this view of the matter correct, we should have few large beds of shells—the shells would be worn smooth by the attrition of the sand, and the genera and species, and the state of preservation or decay, in which they are found, would be continually varying as we approached the ocean. This argument will not apply to the tract of alluvial that lies between the first shells and the fixed rocks, but most persons will be inclined to assign a common origin to the whole of this district.

3. *Though the low country became dry land throughout its whole extent, or nearly its whole extent, at one time, it was not formed by the sudden transportation, from a distance, into the beds which they now occupy, of the sand and clay, which constitute its strata.*

It is now a long time since I read Dr. Hayden's Geological Essays, so that I have but an imperfect recollection of their contents; but I believe he attributes the low country, in part at least, to the currents that have swept across the continent, and brought the sand and gravel of the regions about Hudson's Bay, and deposited them along our seaboard. Of course, that which now occupies the lower district of North Carolina, South Carolina, Georgia, and Alabama, must have been borne across the central and western parts of North Carolina.

That such currents may have swept over the Northern States, I am, from the few faint recollections I have of the beds of sand and gravel, strewed over the interior of the country, inclined to believe. But that they did not pass over the central and western parts of North Carolina, or that if they passed, they brought nothing with them to deposit in the regions south of us—conclusive evidence is furnished by the fact, that no where, on either hill or valley, have they left the least trace of their action. They must have permitted some small quantities of the sand and pebbles they were bearing on, to settle down and remain behind, but none are to be found.

Immediately east of the University of North Carolina, is a bed of red sandstone, about twenty miles across; immediately west, a still broader bed of ancient transition rocks. This is succeeded by a body of granite, not as I believe of the oldest formation, and the granite by the gneiss and mica slate of the Alleganies—about twenty-five miles of the extreme western part of the State, still held by the Indians, belongs to the transition argillite of Tennessee. Throughout the whole line from the Hiwassee on the west, to the commencement of the alluvial on the east, a distance of about four hundred miles, and over all these formations, I have sought carefully for traces of currents and of diluvial action and deposit, but have found none. It is manifest that this entire region was originally thrown up in the state of rock, that this rock has gradually mouldered into the soil that now covers it, and that no foreign matters are mingled with it. Except in the beds of the streams, the gravel is all sharp. There are no marks that a flood of waters, holding any thing suspended, has ever passed over it, or that during the deluge, recorded in the Scriptures, any thing was deposited upon it.

That the low country was not formed by the sudden introduction of the sand and gravel, that compose its strata, *from the quarter of the sea*, or indeed from any quarter whatever, conclusive evidence is furnished by the composition and aspect of the strata themselves.

Passing by the shells, the appearance of which is alone decisive of the point, we may remark that none of the recent beds of fine clay occurring amongst the strata of the globe, can have been produced by a cause that operated suddenly and violently. They cannot be the effect of a rapid motion of any kind, such as the rushing of a current, or the dashing of waves upon the shore. Large bodies of *clay* are never transported like sand in this way, or if this should be thought possible, they will not be deposited in regular horizontal beds. Wherever such beds are found, they prove incontestibly, that over the spot where they now lie, waters rendered turbid by the presence of particles of clay, which they held suspended have stood till the clay was deposited. A single deposition will seldom be sufficient to account for the appearances. When the bed is thick, and especially if it separate readily into thin laminae, or if it be made up of alternate laminae of clay and sand, it will follow, that the same cause has operated there a nnmber of times—that waters holding particles of fine clay suspended, have been repeatedly brought to the spot and detained there, till the earthy matters they contained have subsided.

All these appearances are exhibited by our low country. It is true, as has been already observed, that individual strata are of moderate extent and very variable thickness and composition, yet their appearance is such as to force conviction upon the mind, that they have been deposited from water at rest, and that considerable time was occupied in their formation. They are horizontal or nearly so. The beds of clay are sometimes free from admixtures of sand, but composed of a great number of layers, many of them not thicker than a wafer, that have evidently been added in succession, and sometimes there are alternate layers of clay and sand, from a twelfth to a quarter of an inch in thickness.

4. *The strata of the low country were formed in the bed of the sea, and this district became dry land either by a depression of the level of the ocean, or by the elevation of its bed, by a force operating from beneath.*

In support of this proposition, I can offer only the single argument, upon which all our conclusions in the science of geology must necessarily rest, that, it will account for all the appearances—the perfect preservation of the most delicate ridges, furrows, and processes of the shells—the uniformity of their characters, and the aspect of the beds of clay and sand. The particular by which the geologists of the present day are most remarkably distinguished from their predecessors of the last age, is the extreme caution with which they make their deductions. We are compelled by the evidence that surrounds us on every side, to admit the occurrence of ancient revolutions in the condition of the globe, of the particular causes of which we shall probably remain forever in darkness. The effects and attendant circumstances are so remote from any thing we are in the habit of witnessing, that we are at a loss to conceive of any cause adequate to their production. All that we can do in these cases is to classify the facts. But the nearer we approach to our own age, with the greater safety, apparently, may we reason from the effects to the cause. It is what I have ventured to do in the preceding pages; it being acknowledged on all hands that the formation of the low country is among the more recent geological phenomena. Having satisfied my own mind of the correctness of the views here taken, I determined to submit them to the consideration of geologists; believing that the establishment of a sound and accurate theory, or even an approach to it, always affords us essential aid in the further prosecution of our investigations. If their correctness shall be admitted, there will appear to be no improbability in the idea, that our sand and clay have not been brought to us, from the gulf of Mexico, but are the debris of rocks, that have been worn to pieces in the neighborhood of the places where they now lie, and strewed over the bottom of the sea—sand, from unknown causes, having been deposited in some situations, and clay in others.

Which of the causes, just specified, has produced this encroachment of the land upon the sea—whether a depression of the level of the ocean, or an elevation of its bed, we have no means of determining, from evidence furnished on the spot. We meet, occasionally, amongst the sand hills, with a sandstone and conglomerate of a tolerably firm texture, of which the people living where it occurs, say that it has been melted. But the marks of fusion are not as distinct as they are in the trap rocks. The question will probably be decided in favor of elevation, on the ground of what has been observed and settled in other countries.

Age of the Low Country.

The shells that occur in it prove it to be a recent member of the series of strata, but the forests, by which it has long been covered, prove the era of its emerging from the sea, to be considerably remote. In digging the Clubfoot and Harlow canal, near the mouth of the Neuse river, the remains of both the mastodon and elephant were found. The races to which these remains belonged, are supposed to have become extinct, either before or at the time of the last great catastrophe, that changed the face of the globe. The low country was inhabited, by these animals, therefore, before the time of the deluge recorded in the scriptures.

I am, very respectfully, yours, E. Mitchell.

University of North Carolina, Oct. 10, 1827.

Art. X.—*On the supposed transportation of Rocks; by* J. E. De Kay.

Communicated to the New York Lyceum of Natural History.

Mr. Hayden, in his truly valuable and original essays on geology, alluding to the large masses of rock scattered over the country, coincides with the chief modern geologists, in supposing that they have been transported to these places, by means of torrents and ice. Indeed one of the strongest points in his peculiar geological views, is based upon this supposition, for he not only adopts it to its fullest extent, but by a careful and patient investigation of the surrounding country, endeavors to show the precise locality from whence these detached masses originally came. In almost every instance we believe, he has shown that these bowlders are situated in a direction uniformly south west from the spot, where he supposes them originally to have belonged. These considerations give deservedly great weight to his theory, of a powerful current having at one time swept over the whole continent of America, in a north east and south west direction.*

Without calling in the aid of ice, or torrents, or volcanos or the extravagant hypothesis of Chabrier,† that these isolated rock-masses have fallen from the atmosphere, we suppose that their appearance may *sometimes* be accounted for in a different manner. A fact recently communicated to the Lyceum, suggested the idea.

It is well known that all the southern part of the island of New York, is composed of gneiss covered with sand. Promiscuously scattered over the surface and imbedded in the sand, are bowlders of different sizes, up to several tons in weight. They are totally unlike any rocks, in place, in the immediate vicinity, being chiefly greenstone or trap, occasionally slaty, sometimes granitic and not unfrequently calcareous, containing organic remains.

Agreeably to the ideas generally entertained by geologists, Dr. Akerly‡ has referred the schistose rocks to the region above the Highlands, the greenstone to the pallisado rocks

* Geological Essays; or an Enquiry into some of the geological phenomena to be found in America and elsewhere.—Baltimore 1820.

† Dissertation sur le deluge universel.—Montpelier 1823.

‡ Essay on the Geology of the Hudson river &c.—New York 1820.

on the Hudson, and others, to rocks, similar in composition and structure nearest to the place where these bowlders are now observed. Among other loose rocks, a solitary mass weighing several tons, has for a long period attracted the attention of our mineralogists. It is, or rather was (for it has now disappeared,) at the corner of Broome and Willet-streets, and is called stellated asbestos, although its real nature has not we believe been fully ascertained. It has been always referred to the serpentine rock at Hoboken, from whence according to the received theory, it must have been transported by ice across the Hudson river, to its present situation.

Recently, a bed of serpentine occupying at least twenty acres, and containing the same radiated asbestos, has been discovered on the island nearer to this loose mass. Its greater proximity would then naturally lead us to refer this detached mass, to the newly discovered bed instead of supposing it to have been derived from Hoboken, and subsequently transported across the river. In a line with the large rock and the bed recently discovered, Mr. I. Cozzens, has pointed out another similar mass, about three hundred pounds in weight, near the three mile stone on the middle road.

Reflecting on these circumstances, I have been led to suppose, that wherever these apparently foreign rocks occur, a careful examination of the surrounding country will in many cases, prevent us from looking very far from the spot where they are now found.

Where *secondary* rocks occur scattered over a *primitive* country, it is easy to conceive that the original strata of which they formed a part have been in the course of time, disintegrated and destroyed, leaving a few of the harder portions on the new surface thus exposed. Examples of this sort of destruction of entire strata are numerous. In our own country we need only allude for the present, to a paper by Mr. Barnes in the fifth volume of this Journal, on a geological section of the Canaan mountain.

Where *primitive* rocks, on the other hand, are scattered over a *secondary* or *alluvial* region, we need not look to primitive mountains several hundred miles distant, in order to find their origin. We know that primitive rocks, frequently thrust themselves through all the superincumbent strata. Now on the supposition that these peaks may have been destroyed by some convulsion of nature, or by the resistless tooth of time, and their origin concealed by the detritus, we can account very naturally for their appearance in a region, to which they are apparently strangers. The speculative part of geology is, at present, but a series of hypotheses, and we may admit temporarily the most probable. In every case we should admit that which explains the phenomena of nature in the simplest manner.

Art. XI.—*Reply to Mr. A. B. Quinby's Question, at page 74, of this volume;* by E. W. Blake.

TO THE EDITOR.

Sir—A little more attention on the part of Mr. Quinby, to the communication of mine, which has drawn forth his reply to me in your last number, will satisfy him that, as I neither stated nor pretended to state, either his *ideas* or his *language*, on the points referred to, so I cannot have "*misrepresented*" him on those points. By the same means, he will also perceive, that I have no where charged him with the error of having made a direct comparison between two unlike quantities: and when he fully comprehends the nature of the distinctions on which my argument was founded, he will see most clearly, that I have not fallen into that error myself.* That Mr. Quinby has not apprehended the nature of those distinctions, is evident from the irrelevant question concerning them, with which he has concluded his remarks.

Being engaged in active business, I have neither time nor inclination to write for the sake of disputation, and shall, therefore, pass over Mr. Quinby's strictures, without further comment; not doubting that the above hints will enable him to set himself right. But to the question just referred to, I shall reply at length, embracing the opportunity which it gives me, to illustrate the distinctions on which my argument, relative to the crank, and other machinery was founded. These distinctions I would recommend to the particular attention of Mr. Quinby, and any other of your readers who are engaged in the pursuit of mechanical science, as con-

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* Mr. Quinby's measure of *tendency to rotation* is correct, for the purpose of *comparing* tendencies at different distances from the centre of motion; but it is no measure of a *determinate* tendency, at an assumed distance.

ducting to a method of contemplating mechanical power, which will very much abridge the labour of acquiring definite ideas with regard to it; if indeed it be not the only medium through which such ideas can be attained. This method of considering the subject, opens a door of immediate access to many arcana of the science, at which our predecessors have arrived, by a far more tedious and intricate path; and developes others, in the pursuit of which they have all been led astray.

The part of my communication to which Mr. Quinby's question refers, is as follows, viz:—

"A certain power will exert a pressure of ten pounds."

"Another will drive a body against a given resistance ten feet."

"Another will elevate water one foot, at the rate of one gallon per minute."

"The powers necessary to produce these several effects are definite, and may be definitely measured, by referring them respectively to their proper standards. But even after this is done, no one can say that either of them is equal to, or by how much it is greater or less than another, because they are dissimilar in their nature. The first consists of one attribute only, like linear measure. The second, of two, like superficial measure. The third, of three, like solid measure. To say, therefore, that one of them is greater or less than another, would be as absurd as to say that a mile is greater than a square foot, or that a square foot is less than a cubic inch."

Mr. Quinby's reference to this, and question, are as follows:—

"At page 339, he [Mr. Blake] says, 'another [power] will drive a body against a resistance* ten feet;' this, he states, contains but *two attributes;* but can a body move ten feet without occupying some portion of time? and if it occupy *any* portion of time, does not this example contain the *three attributes?* How then does Mr. Blake find the same difference between *this* example and the *third*, that there is between a *square* foot and a *cubic* foot?"

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* I said "a *given* resistence." The word, *given,* (the omission of which was doubtless accidental,) is not important as it respects the purpose for which Mr. Quinby made the quotation, but it is essential in the *connection in which it stands* in my piece.

Mr. Quinby's embarrassment has arisen from not distinguishing power, in the sense in which the second example requires its mensuration, from power in another sense, in which the mensuration of it is not required by the example ; and for the mensuration of which the example does not furnish the data. The three examples were carefully selected, as furnishing data for the mensuration of three distinct species of power or of power presenting itself for mensuration, under three different aspects. The first requires the mensuration of power, without relation to *time* or *space.* The second requires the mensuration of power in its connexion with *space,* but without relation to *time.* The third requires the mensuration of power, in its connexion with space, and also in its relation to time. The quantity sought by the first example, is a simple determinate quantity ; that sought by the second, is a determinate product of two simple unlike quantities ; and that sought by the third, is indeterminate, being merely a ratio of a product of two simple unlike quantities, to a third quantity, unlike either of them. It is true that a lapse of time will necessarily attend the operation of the power, mentioned in the second example ; but the operation of a power may be attended not only by this, but by a variety of other circumstances, which may, or may not, become attributes in the mensuration of the power, according to the purpose for which the mensuration is made. It is the purpose for which the mensuration is made, or in other words, *the nature of the quantity sought,* which determines the number of attributes of which the power to be measured consists. For those circumstances, and those only, attending the operation of a power, *which affect the amount of the quantity sought,* are to be taken as attributes of the power to be measured. Circumstances or incidents, which do not affect the amount of the quantity sought, cannot be said to be attributes of the power to be measured, however inseparable their occurrence may be, from the operation of the power. In the mensuration of the power, which produces the result specified in the second example, it is manifest that *time* cannot affect the amount of the quantity sought ; for it will require the same *quantity* of power* to produce that result, whether it be effected in a moment, or in a twelve month, or in any longer or shorter period

* The phrase, *quantity of power* is here used, as in my former communication, to denote the product of the degree of force and distance.

of time whatever; and if we could even suppose this result to take place without the lapse of time, it would still require the same quantity of power to produce it.

For the illustration of these points, with regard to the mensuration of mechanical power, let us take a familiar example in the mensuration of other objects. The distance between the cities of New-York and New-Haven, by road, is the same, whether the road be wide or narrow; and if we could even suppose the road to have no width at all, the distance would still be the same. In measuring the road for the purpose of ascertaining the distance, it is the *length* of the road, which is to be measured, and which is the quantity sought; and of this quantity, the *width* of the road is not an attribute, however inseparable width may be from the existence of the road.

It is believed, that Mr. Quinby will now perceive, that *time* has nothing to do with the quantity, of which the second example requires a mensuration. But as these distinctions can not be too much insisted on, for the sake of further illustration, and also to show the analogy, which subsists between the mensuration of power, under the distinctions pointed out, and the mensuration of other objects, let us take another familiar example. Suppose I should say to Mr. Quinby, that I have a board, which will exactly reach from a certain point to a certain other point, which two points are $3\frac{1}{3}$ yards asunder. Mr. Quinby, upon this statement of the case, immediately perceives that I have furnished him with data for determining the *length* of the board, and replies, that it must be 10 feet long. And this is all he can determine with regard to the dimensions of the board, notwithstanding it is certain that the board must have width and thickness, as well as length. Suppose I should then say, that the board is also 12 inches wide, and require, as before, the measure of it. He will now determine the *area* of the board, and reply, that it measures 10 square feet. I next say, that the board is also one inch thick, and require again its measure. He will now determine the *solid contents*, and reply, that it measures $\frac{10}{12}$ of a cubic foot. Thus, in the mensuration of the board, three different quantities have been obtained, corresponding with the data respectively furnished. Just so, the three examples for the mensuration of *power*, require the measurement of three different quantities, corresponding respectively with the data furnished by the example; and, as in the case of the board, the three different quantities all arise in the mensuration of one and the same board; so the three examples for the mensuration of power, may all be drawn from one and the same operation of power. For example; suppose that we have ascertained with regard to a steam engine, which is in operation, that the pressure on the piston is five hundred pounds. We may now tell what degree of resistance, if directly applied, will be overcome. Suppose we next ascertain the *area* of the piston, and that five hundred cubic feet of the steam have been expended in giving it motion; we may then tell, what determinate *quantity* of mechanical effect it might have produced, if properly applied. Suppose that we next ascertain, that the steam in the boiler is maintained at a uniform density, when it is drawn off at the rate of fifty cubic feet per second; we may then tell the magnitude of the effect, in relation to time. These three examples, drawn from the steam engine, correspond exactly with the three examples before given; except that in these, the effect is to be determined from the power, while in those before given, the power was to be determined from the effect.

No other distinctions are here insisted upon, in the mensuration of power, than such as we always make, in the mensuration of other objects. In the mensuration of other things, we have different names for the different sorts of quantities that are obtained, expressing respectively, the nature of the quantity; as, *length*, *area*, *contents*, specific gravity, &c. and the distinctions are made, as a matter of course, and without reflection. But in measuring power, we have no appropriate names to designate the different natures of its dimensions, and hence it is, that they are so often confounded. We readily perceive, into what confusion and embarrassment we should be immediately thrown, by discontinuing the use of the terms, *length*, *area*, *contents*, &c. and substituting for them the general term, *measure*. From an equal amount of the same kind of embarrassment and confusion, with regard to the mensuration of mechanical power, should we be immediately relieved, by the introduction of appropriate terms, to distinguish, without circumlocution, the different natures of its dimensions. Whoever shall introduce these terms, so that they shall come into general use, will, in my view, have contributed in no small degree, to the advancement of this branch of science.

The quantities, which most require to be distinguished by appropriate names, appear to me to be these, viz.

I. That which I have *called degree of power;* or power in its most limited sense, without relation to time, space, or velocity.

II. Power, as a magnitude, varying with *time* only.

III. Power, as a magnitude, varying with *space* only.

IV. Power, as a magnitude, varying with *velocity*, that is, with space directly, and time inversely.

The method usually pursued by writers on this subject, is to treat power as an object having but one dimension, and to consider the circumstances of *time*, *place*, and *velocity*, merely as *multiples* of it. The method I would propose, is, to treat power, as an object having several dimensions; and to consider the circumstances of time, space, and velocity, as *constituents* of it. By their method of considering the subject, authors have often been led into the most circuitous mazes of analytical investigation, in order to discover truths, when the very same truths would flow almost spontaneously, from self evident principles, which will immediately suggest themselves, in the method of considering the subject, here proposed. The doctrine of percussion, as copied by Gregory from Don Juan, is a remarkable instance of this kind. Every useful result, which he has there deduced from many pages, may be drawn, with much more clearness, from as many lines. Had this method of considering the subject been pursued, by those who have contributed the theorems which now constitute our volumes of mechanical science, those volumes would have contained fewer errors. It is these errors which have given rise to so many complaints, of the difference between the results of theory and practice, and which have brought the science into disrepute. Of these errors, the absurd doctrine of the "maximum effects of machines," is a prominent example. This doctrine was justly condemned by Mr. Quinby, in a recent number of your Journal; and though I think he is mistaken, with regard to the error, on which the fallacy of the doctrine is based, he is, in my view, entitled to no small credit, for having perceived and exposed its absurdity.

Art. XII.—*Rejoinder of* Mr. Quinby *to the writer of the examination of his Principle of Crank Motion.*

TO THE EDITOR.

Sir—The allusion, which the writer of the article entitled, "Examination of Mr. Quinby's Principle of Crank Motion," has made in the last number of this Journal, to a private communication from yourself to me, makes it necessary for me to state to the public, all the facts relative to the communication alluded to. By referring to my reply it will be seen that it is dated March 28. The private letter I received from you, in which you communicated the errata you had received from the writer of the 'examination,' is dated April 28; and was received by me two days after that date. The following is a copy of that part of your letter, which relates to the errata you communicated.

"I requested a mathematical friend to look over your late communication, in reply to the writer who criticises you, and to compare it with a list of errata which had been forwarded to me, by the author alluded to above." In reply, my friend has handed to me the following remarks:—

"Among the errors pointed out by ——, the only one noticed by Mr. Quinby, is that which occurs at page 126, line 14 from the top, where, (as would seem from the printed demonstration,) C*c* and C*e*, two unequal lines, are found to be the same. This was an error of the author, for it is printed precisely as it stood in the MS. Yet it is not altogether candid in Mr. Quinby to avail himself of it, for it is evident that the writer intended to have the terms taken *alternately*, though he forgot to repeat them in that order. Thus, as printed, it stands as follows:—

$$am : a\mathrm{S} :: \mathrm{C}c : \mathrm{CS}$$
$$dn : a\mathrm{S} :: \mathrm{C}e : \mathrm{C}t$$

where the writer infers, that the *third* terms are the same; he evidently should have said the second, namely, aS. But his conclusion is correct, and is precisely the same as though he had taken the terms alternately, in which case aS would become the *third* term in each couplet, viz. $am : \mathrm{C}c :: a\mathrm{S} : \mathrm{CS}$ and $dn : \mathrm{C}e :: a\mathrm{S} : \mathrm{C}t$: the whole error consists in accidentally saying third for second—a mistake evidently accidental, and one which it is unfair for a disputant to avail himself of, as every reader will perceive."

A list of errata, forwarded by the author to me, is as follows: page 124, line 5 from bottom, for circle "*v c l* G," read circle *v l* G *w*; page 126, line 4 from top, for "$\frac{P \times rad}{cos.Atd} = Cc$," read $\frac{P \times rad}{cos.Atd} \times Cc$. Page 126, l. 13 from top, for "But C*ed*," read But C*e*. Page 126, l. 14 from top, for "*am* : *a*S :: C*c* : CS and *dn* : *dt*, (or *a*S,) :: C*e* : C*t*," read *am* : C*e* :: *a*S : CS and *dn* : C*c* :: *dt*, (or *a*S,) : C*t*. Page 126, l. 11 from bottom, for "refutation," read repetition. I would have sent you these notices earlier, but it has been out of my power, &c.'

From the part of your letter which I have quoted, it will be seen, 1st, that my reply was written a month, (and had been in your hands two weeks,) before I received the communication alluded to; and 2nd, that in no part of the communication is it intimated, that it was made at the request, or with the knowledge of the writer of the 'examination.' The next thing which it is proper to state to the public, is, the manner or view in which I received this communication, and the answer I returned to the suggestions which your mathematical friend and yourself had made. I received the communication as the voluntary offering of the Editor of the American Journal of Science and Arts, in a private correspondence. The answer I returned was, that I thought that the error in question was not of that class which is properly denominated errata. I gave my reason for this opinion, and declined making the alteration in my reply, which your friend and yourself had suggested. I also stated, (on this point I write from memory,) that if the error in question were of that class which is properly denominated errata, I still could not see that I was bound to treat it as your friend and yourself had proposed—the usual course in such cases being for each writer to correct his own errata. In concluding my answer, however, I gave you a note, which I requested might be added at the bottom of a suitable page, of my reply. This was done.

I have now stated all the facts, (at least all that are known to me,) relative to the communication to which the writer of the 'examination' has alluded, and without offering any comment, and with but one remark, I will submit it to the public to judge whether I was bound to treat the error in question differently from what I did or not.

The terms of the propositions that are in the 'examination,' require to be taken both *alternately* and *in cross order*:* the author, in his correction, has written them *in cross order*. The error cannot, therefore, be considered *accidental.*

In concluding this rejoinder I will inform the author of the 'examination' that there is no other part of his 'answer' which I deem it important to notice. I have never possessed the hope that I should be able to convince him of the truth of my demonstration, or of the errors in his; and I have neither time nor inclination, to pursue a controversy which I think can never convince my antagonist, or afford benefit to the public. My reasoning on the *crank problem* is given in my demonstration: and the public have the means of judging whether there is, or is not a loss of power.

I will add one remark to the public, and take my leave of the *crank problem* forever. There is at this time an amount of power passed through the *crank*, to various appended machinery, equal to the labor, daily, of half a million of men. If therefore, it would be important to know whether the labor of half a million of men be efficiently applied, it is equally important to know whether there is or is not a loss of power, occasioned by the *crank*. A. B. QUINBY.

Sept. 6, 1827.

The private communication to Mr. Quinby was made at the request of the author.—EDITOR.

ART. XIII.—MR. BARNES'S *Reclamation of Unios.*

(Read before the Lyceum.)

TO PROFESSOR SILLIMAN.

New York, Nov. 12, 1827.

Dear Sir—IN looking over the continuation of Humboldt and Bonpland's Zoological Observations, just received, I observe, that a portion of that splendid work is devoted to

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* When I wrote the note, (which was written without having the 'examination' or the communication alluded to before me,) I did not perceive that the terms required *also* to be taken *in cross order*.

American Unios, of which the author, Mons. A. Valenciennes, describes *nine* species, all of which have been previously described by American naturalists, either under the same or different names; but, in several instances, no notice is taken of the original author, from whom those names were derived. This is a singular oversight, in the French naturalists, who have been distinguished by their liberality towards American authors; inasmuch as these shells have been sent to the Baron Ferussac, and set forth in his excellent Bulletin, with all due praise. It is an act of duty to Mr. Say and myself to notice this departure from the law of naturalists, *that priority must have preference*, in all regular publications. I have, however, no doubt, that the oversight was unintentional, and such as will sometimes unavoidably occur. After the publication, in your sixth volume, of the shells brought from the northwestern territory, in 1820–1, I was shown a paper by Professor Rafinesque, published in Brussels, without a date, in which I discovered some of those which I had published. I am not sure which had the priority, but if it belongs to Mr. R. that circumstance probably occurred from the delay in printing the paper in your Journal, caused by my absence from the city, during the prevalence of the yellow fever, and several other unfavorable events. The want of a date in Mr. R.'s paper, sent to Dr. Mitchill, the only one I have seen, was I believe, owing to its being a part of a larger work of which some extra copies were bound up for the author. Mr. R.'s paper was totally unknown to me at the time of publishing mine, as you will perceive by the introduction, in which Mr. Say's paper is mentioned as the only one then known.

In the paper of A. Valenciennes, which is the subject of this reclamation, Mr. Rafinesque is mentioned but not followed; and the author's view appears just and reasonable, which is to leave the genus as it now stands, and not to constitute other genera from it, by the external form of the shells. Mr. Say is also respectfully mentioned, but no notice whatever is taken of the paper in your sixth volume, though *several of the same species are set forth under the same names*, even those of which you have given plates; and others are republished under different names. I shall notice them in detail with corrections to each.

1. Unio ovata. (ova*tus.*)—The gender of the word *Unio* is again mistaken. It is masculine. This error is noticed in

your Journal, Vol. vi, page 115; and has since been corrected by Dubois, the translator of Lamarck, in his synoptical table, page 30th. This Unio is referred to Lamarck, vol. vi, page 75, No. 23, and Lamarck in this place quotes Say's American conchology, pl. 2, fig. 7. Now it so happens, that the shell thus referred, is not Mr. Say's *Unio ovatus*, but his U. cariosus, in a young state, and the author is correct in saying, that it nearly approaches the Unio cariosus, of Lamarck, vol. vi, p. 226. The *Unio ovatus*, of Mr. Say, is eminently distinguished by a slightly elevated obtuse keel around the anterior slope, (*posterior* of Cuvier and Blainville.) See American Journal of S. and A. vol. vi. p. 113.

2. Unio Dombeyanus.—The author has made two species of Lamarck's *Unio Peruvianus*. The one is what I have named *Unio rugosus*, with a plate and description, in the Journal, vol. vi, p. 126, and the other is the

3. Unio undulatus.—The same shell as that figured in the Journal, with the same name, and from the same locality, the *Ohio river*. In the Journal, vol. vi, p. 120, Lamarck's Unio Peruvianus is quoted with a mark of doubt. The same reason which caused that doubt, has induced M. Valenciennes to recommend, that Lamarck's name should be discontinued. It comes from the Ohio, and not from Peru. The shell here figured is a younger and smaller one than that figured in the Journal.

4. Unio verrucosus.—This, again, is our shell with the same name. It is the variety (*b*) mentioned on page 124, which is always much less than the one figured in the Journal. The dimensions of the plate, of M. Valenciennes, are the same as those of our shell.

5. Unio tuberculosus.—This is the young of our U. verrucosus, and not as the name might seem to indicate, our *U. tuberculatus*.

6. Unio Rostratus.—This the author marks *Nobis*. It is Mr. Say's well known *nasutus*, but not the *nasuta* of Lamarck, which circumstance probably led him into the error. Lamarck's name should be changed, and Mr. Say's must have preference. Both the names, *nausutus* and *rostratus*,

are descriptive of the same character of the shell—the unusual extension of the anterior side. (See Journal, vol. vi, p. 110—111, and p. 273, No. 26.)

7. Unio naviformis. Lam.—For this, both Lamarck and this author refer to Mr. Say's Unio cylindricus, with a mark of doubt. It is the same. Mr. Say's figure represents an old shell from Dr. Barton's collection, now in the Philadelphia museum, and the figure of this author represents one which is rather younger and smoother than an intermediate one now in my collection, received from Mr. King of Buffalo, and by him brought from the Ohio. This species, of which we have now several specimens, was mentioned, p. 127 of the Journal, but not described as it had been previously described, by Mr. Say, and as one specimen only had then been found; and it seems there is yet only one known in France, which one was carried thither by the younger Michaux, and given to the museum of natural history.

8. Unio rectus.—This shell resembles the Unio prælongus, of the Journal, and, indeed, it has been supposed to be the same. Lamarck's shell is, however, much less in size, and uniformly, as far as my observations have extended, differently colored on the inside. The *rectus* has the inside either white or with a pale tinge of red, and the *prælongus* is of a deep and splendid purple. The variety, with the inside whitish green, mentioned in the Journal is the *Unio rectus*, of Lamarck, which name, and not his *purpuratus*, has the preference to ours.

Most beautiful specimens of the Unio rectus are found in Lake Champlain, at Ticonderoga point.

9. Unio hians.—This is the *Alasmodonta undulata*, of Mr. Say; a genus which the French have not yet admitted into their books. It is, however, a natural genus, of which we have now five or six well characterized species; every one of which may be instantly distinguished from the Unios, by the *color* and peculiar *smell* of the animal, and by the *yellowish tinge* on the inside of the shell. It is a matter of regret that the animals have not yet, to our knowledge, been carefully examined by an acute and discriminating comparative anatomist. They will, no doubt, prove to be different. It is remarkable that this genus should still be included under the *Unio*, when it has

not the generic characters of that genus. It always wants the LONG, COMPRESSED LATERAL TOOTH, which Lamarck inserts as a part of his generic description, (alter (sc. dens) elongatus, compressus, lateralis, infra pubem productus,) Lam. Genus Unio, vol. vi, p. 69; and yet, Lamarck himself, has put a shell of exactly this kind, at the head of his genus Unio. This fact led me into a mistake concerning the *Alasmodonta arcuata*, which is Lamarck's *Unio sinuatus*, and the *Mya margaritifera*, of authors; and Lamarck has again described the young of this same species, under the name of *Unio elongatus.* Neither of these ever has the long, compressed, lateral tooth. They, therefore, belong properly to Mr. Say's genus, ALASMODONTA. Am. conch. p. 14—15. Both the young and the old, answering to the two species of Lamarck, just mentioned, are figured in the Journal, vol. vi. pl. 12. The same shell is figured by Pennant and Lister. It is very remarkable, that a shell found in our waters, should be so exactly like one found in Europe. This species, though so well known abroad, was unknown to Mr. Say, when he published his treatise. It was brought to me from Tappan and Canada creek, in this state, and being unknown to Mr. Say, I supposed it new, and so described it.

I find it difficult to believe, what seems to be a very plain fact; I suspect there must be some mistake: the figures and description of this shell seem to show an exact identity, and we have compared ours with specimens labeled, *Mya margaritifera*, from Liverpool, Eng. They are the same; and yet, if the *Unio sinuata*, of Lamarck, has the long, lateral, lamelliform tooth, ours is a different shell, and the original name must stand. If that is the fact, neither of us has made a mistake. In the case of the *Unio hians*, of M. Valenciennes, we seem to perceive the same error as that above imputed to Lamarck. His shell is from our waters, and we have numerous fine specimens, all of which are destitute of the lateral tooth, by which the genus *Unio* is characterized.

This natural and useful genus contains now six species, as follows:—

1.	Alasmodonta	margaritifera, Mya L. Unio, Lam.	
2.	"	complanata,	American Journal, vol. vi, p. 75—80.
3.	"	rugosa,	
4.	"	marginata,	Say, Am. conch. l. c.
5.	"	undulata,	
6.	"	purpurea, of M. Valenciennes, mentioned below.	

All these, except the last, are known to us as well characterized, and perfectly distinct; and to persons less cautious than we are, the northwestern expedition might have afforded an opportunity of increasing the number. (See Journal, vol. vi. p. 279.)

This paper of Mons. Achille Valenciennes, on the *Naiades* terminates, with an account of two Anodontas: the first is called *Anodonta glauca*, which is said to be new. It is well known to us, and is Mr. Say's *Anodonta marginata.* The Anodonta has numerous *varieties*, but I have yet seen no evidence of more than one *species;* although Lamarck describes *fifteen*, Mr. Say, *two;* this author, *two;* and others, more. In the same way it would be easy to increase the number to a hundred; but they would all be more alike than the numerous varieties of the Unio purpureus. The identical variety here figured has been brought from our southern waters, and laid on the table of the Lyceum, without being supposed worthy of particular notice.

The next the author calls *Anodonta purpurea*, which without doubt, is another of Mr. Say's genus *Alasmodonta.* This is evident from the figure, and the following part of the description. "Cette espèce est très remarquable par l'epaissement du bord inférieur, sous les crochets." I believe that no one ever saw an *Anodonta* thickened about the beaks. They are always thin, and uniformly thin throughout. But this is not all. "Ce bord un peu relevé, semble montrer un commencement du dent, et conduire ainsi vèrs la charnière des mulettes." This again is never found in the proper *Anodonta*, but it is a very good description of a young *Alasmodonta* before the teeth of the hinge are fully formed. When this shell is again examined the learned author will find, if my conjecture is right, on the inside, near the hinge, where the shell is thickened, a tinge of yellow. The animal, when extracted, was yellow, and had a rank, offensive smell, different from the fresh and not unpleasant smell of the Unios. The description of the *Unio hians*, mentions the same appearance about the cardinal tooth, "sous cette dent le test est très-épais: il devient ensuite tres-mince." This is an exact description of the Alasmodonta, which is common to several species, but not often seen in the *Unio*, and never, to my knowledge, in the *Anodonta.*

We are gratified to perceive, that the method of measuring shells, and inserting the length, breadth, and diameter;

(which method was commenced and recommended in this Journal,) is uniformly pursued in this paper. It has also been adopted in England. But the French, instead of *diameter*, use *thickness;* as it seems to us, with less propriety, for the reasons given, vol. vi, p. 111.

We regret to see the exploded error, of the axolotl's being the larva of a water salamander, again put down as a matter of undoubted science. It rests, indeed, here as elsewhere, on the authority of Cuvier; but even that authority cannot support it against a simple examination of the specimens now in the New-York Lyceum. The animal is, beyond all doubt, mature and distinct from all others.

Your cordial friend,

D. H. BARNES.

Art. XIV.—*Notice of the pressure of the Atmosphere, &c. within the Cataract of Niagara, in a Letter from Captain* Basil Hall, *Royal Navy*, F. R. S.

TO PROFESSOR SILLIMAN.

New York, Oct. 29, 1827.

My Dear Sir: If you think the following notice of an experiment which I made at Niagara, early in July last, worthy of a place in your excellent Journal, it is much at your service.

You may remember, perhaps, that some time ago, it was suggested by Messrs. Babbage and Herschell, in a paper, I believe, upon barometrical measurements, that there was reason to suspect a change of elastic pressure might be found in the air near a water fall; and it occurred to me, when I was making preparation for the present journey, that a good opportunity, for bringing this subject to the test of experiment, might present itself at the Falls of Niagara. I accordingly provided myself with a mountain barometer, of great delicacy of workmanship, in some degree differently fitted up from the ordinary instruments of this description; and it may be worth while, to mention the particulars of its construction.

In the first place, as it is essential to the accuracy of barometrical measurements, that the tube be held in a vertical position, and as the instrument is often exposed, especially at the upper stations, to the action of high winds, it is of consequence to have some method of ensuring this position throughout the observations. Mr. Thomas Adie, instrument maker, in Edinburgh, in conjunction with Mr. Jardine, the eminent civil engineer, devised a small fixed circular spirit level on the top of the instrument, the bubble of which is made to stand at the centre, when the tube is perfectly upright. In order to bring it to this position, four screws are necessary at the collar, near the centre of motion, by which not only the requisite adjustments are made, but the instrument can afterwards be firmly secured in its place. In other respects, it did not differ from the best mountain barometers, where both surfaces of the mercurial column are capable of being observed; and where, consequently, the observation being direct, no allowances or corrections are required.

Some days after reaching Niagara, I went behind the sheet of water, on the Canada side of the Falls, and although circumstances did not promise very favorably, I resolved to try what could be done with the barometer, in a place where no similar instrument had probably ever been set up.

I think you told me that you did not enter this singular cave on your late journey; which I regret much, because I have no hope of being able to describe it to you. In the whole course of my life, I never encountered any thing so formidable in appearance: and yet, I am half ashamed to say so, as I saw it performed by many other people, without emotion; and it is daily accomplished by ladies, who think they have done nothing remarkable.

You are perhaps aware, that it is a standing topic of controversy, every summer, by the company at the great hotels, near the Falls, whether the air within the sheet of water is condensed or rarefied; I had therefore a popular motive as well as a scientific one, in conducting this investigation. And the result I hope, will prove satisfactory to the numerous persons who annually visit Niagara.

As a first step, I placed the barometer at the distance of about one hundred and fifty feet, from the extreme western end of the Fall, on a flat rock, as nearly as possible on a level with the top of the 'talus' or bank of shingle, lying at the base of the over-hanging cliff, from which the cataract descends. This station was about thirty perpendicular feet above the pool or basin into which the water falls. The mercury here stood at 29.68 inches. I then moved the instrument to another rock, within ten or twelve feet of the edge of the fall, where it was placed by means of a levelling instrument, exactly at the same height as in the first instance. It still stood at 29.68—and the only difference I could observe, was a slight continuous vibration of about two or three hundredths of an inch, at intervals of a few seconds.

So far all was plain sailing: for though I was soundly ducked by this time, there was no particular difficulty in making these observations. But within the sheet of water, there is a violent wind, caused by the air carried down by the falling water, and this makes the case very different. Every stream of falling water, as you know, produces, more or less, a blast of this nature: but I had no conception that so great an effect could have been produced by this cause. I am really at a loss how to measure it—but I have no hesitation in saying, that it exceeds the most furious squall or gust of wind I have met with in any part of the world. The direction of the blast is generally slanting upwards, from the surface of the pool, and is chiefly directed against the face of the cliff, which being of a friable, shaly character, is gradually eaten away; so that the top of the precipice now overhangs the base thirty-five or forty feet; and in a short time, I should think, the upper strata will prove too weak for the enormous load of water, which they bear, when the whole cliff will tumble down. These vehement blasts are accompanied by floods of water, much more compact than the heaviest thunder shower; and as the light is not very great, the situation of the experimenter with a delicate barometer in his hand, is one of some difficulty. By the assistance of the guide, however, who proved a steady and useful assistant, I managed to set the instrument up, within a couple of feet of the "termination rock," as it is called, which is at the distance of one hundred and fifty-three feet from the side of the water fall, measured horizontally along the top of the bank of shingle.

This measurement, it is right to mention, was made a few days afterwards, by Mr. Ed. Deas Thompson, of London, the guide, and myself, with a graduated tape.

While the guide held the instrument, firmly down, which required nearly all his force, I contrived to adjust it, so that the spirit level on the top indicated that the tube was in the perpendicular position. It would have been utterly useless to have attempted any observation without this contrivance. I then secured all tight, unscrewed the bag, and allowed the mercury to subside: but it was many minutes before I could obtain even a tolerable reading, for the water flowed over my brows, like a thick veil, threatening to wash the whole affair, philosophers and all, into the basin below. I managed, however, after some minutes delay, to make a shelf or spout with my hand, which served to carry the water clear of that part of the instrument which I wished to look at, and also to leave my eyes comparatively free. I now satisfied myself, by repeated trials, that the surface of the mercurial column, did not rise higher than 29.72. It was sometimes at 29.70, and may have vibrated two or three hundredths of an inch.

This station was about ten or twelve feet lower than the external ones, and therefore I should have expected a slight rise in the mercury; but I do not pretend to have read off the scale, to any great nicety; though I feel quite confident, of having succeeded in ascertaining, that there was no sensible difference between the elasticity of the air at the station on the outside of the falls, and at that, one hundred and fifty-three feet within them.

I now put the instrument up, and having walked back towards the mouth of this wonderful cave, about thirty feet, tried the experiment again. The mercury stood now at 29.68, or at 29.70, as near as I could observe it. On coming again into the open air, I took the barometer to one of the first stations, but was much disappointed though I cannot say, surprised, to observe it full of air and water, and consequently, for the time, quite destroyed. My only surprise indeed was that under such circumstances, the air and water were not sooner forced in. But I have no doubt that the two experiments on the outside, as well as the two within the sheet of water, were made by the instrument, when it was in a correct state; though I do not deny, that it would have been more satisfactory to have verified this, by repeating the observations at the first stations.

On mentioning these results to the contending parties in the controversy, both sides asked me the same question. "How then, do you account for the difficulty of breathing, which all persons experience, who go behind the sheet of water?" To which I replied, "that if any one were exposed to the spouts of half a dozen fire engines, playing full in his face, at the distance of a few yards, his respiration could not be quite free; and for my part I conceived that this rough discipline would be equally comfortable in other respects, and not more embarrassing to the lungs, than the action of the blast and falling water, behind this amazing cataract.

I remain most sincerely your obedient servant,

BASIL HALL.

ART. XV.—*On the non conducting power of water in relation to heat; by* W. M. MATHER.

WATER has by some been considered as a conductor, by others a non-conductor of heat downwards. Count Rumford, seems to have been the first who developed the manner, in which fluids receive an increase of temperature. He observed during the cooling of water in a glass vessel, two currents running in opposite directions. The exterior one was directed from the upper to the lower part of the vessel—the other passing through the centre from the bottom to the surface of the fluid. The reason of this is perfectly evident; the particles of the fluid adjacent to the surface of the vessel, give up a portion of their free caloric, and become specifically heavier than the neighboring ones, in consequence of which, they sink to the bottom, displacing others that are warmer, which rise to the surface, give out a portion of their caloric and sink in their turn to give place to others. This motion of the particles continues, until the fluid acquires the same temperature as the surrounding bodies. The Count conceived that if the motion of the particles could be prevented, the fluid would not receive an increase of temperature. He rendered this highly probable; for by introducing into water, substances not chemically soluble in it, it was found that the tendency to receive an increase of temperature (when exposed to heat) was diminished in proportion, as the motion of the particles was retarded. From this he inferred, that water could not conduct heat, except by the motion of its particles. Dr. Murray's experiment to shew that water is a conductor of heat downwards, seems at the first glance to be conclusive.

The following account of it is given in Websters Manual of Chemistry. "If we carefully pour hot oil upon water, in a tall glass jar with delicate thermometers placed at different distances under the surface, it will be found that those near the heated surface indicate increase of temperature; it might here be said, that the heat was conducted by the sides of the jar, and so communicated to the water; to obviate such objection, Dr. Murray made the experiment in a vessel of ice, which being converted into water at 32° cannot convey any degree of heat above 32° downwards, yet the thermometers were affected as in the former trial." From this experiment, Dr. Murray draws his conclusion, that *water is a conductor of heat downwards.* Is it not as probable that the thermometers beneath the surface of the water (in the preceding experiment,) were affected by *radiant heat* from the heating body, as by *conducted heat?* This question suggested itself to me while reading the preceding experiment. It is a well known fact, that highly polished metals, reflect radiant heat perfectly, and are excellent conductors. If then in the apparatus used by Dr. Murray, a burnished metallic disk be placed between the surface of the water and the thermometers, it is evident that it would not prevent the passage of caloric by conduction, so that should the thermometer be affected under these circumstances, it would show that water did conduct heat downwards. All heat that might radiate from the heating body, in the direction of the thermometers, would be reflected off by the disk, so that all possibility of caloric passing from the heating body, except by conduction, is intercepted. During the months of January and February last, I made many experiments upon this subject. I am under many obligations to Dr. Torrey for his assistance, and for furnishing the necessary apparatus. The first few experiments were of no avail, from the circumstance that the thermometer was not of sufficient delicacy to detect a change of temperature, either when the plate was, or was not interposed.

An air thermometer was then constructed, of such delicacy that a change of temperature of $\frac{1}{100}$° of Fahrenheit, would drive the bead of fluid along the stem one inch. The stem of the thermometer was luted into the tubulature of a common gas receiver, so that when the receiver was inverted and filled with water, the bulb was covered to the depth of from half an inch to one inch. The receiver was coated internally and externally with ice, from half to three quarters of an inch in thickness, placed upon a stand, and filled with water, which (having ice dissolving in it) remained at 32°. A few drops of ether were poured carefully upon the surface and inflamed. The bead of fluid moved along the tube about one inch, indicating a change of temperature in the air of the

thermometer of $\frac{1}{100}°$ of Fahrenheit. The polished metallic disk was then carefully introduced, resting upon the bulb of the thermometer. Ether was then again poured upon the surface of the water and inflamed. In this case, the bead of fluid in the stem, did not move in the least sensible degree. These experiments were many times repeated, and the uniform results were, that when no plate was interposed to intercept the radiant heat, the bead was moved along the stem of the thermometer, and when the plate was interposed, no appreciable effects were produced. A cannon ball heated to redness, and suspended within one or two inches of the water, was substituted for the inflamed ether, and with the same result.

The conclusion to be drawn from these experiments is, that *water is a non-conductor of heat downwards.*

Another proof equally strong of water being a non-conductor of heat downwards, is mentioned by Mr. Perkins, in his explanation of the bursting of some steam-engines. In some cases, the steam above the surface of the water in the boiler, was of a temperature equivalent to a red heat, although the water was not heated very highly, neither was it under a great pressure. In that case, had water been capable of conducting heat downwards, a portion of it would have been converted into highly elastic steam, by rèceiving an additional portion of caloric from the surcharged steam above its surface. It appears highly probable that other fluids, elastic and non-elastic, are governed by the same law as regards their conducting powers. I have not performed a series of experiments upon any other fluid than water, but it is my intention so to do, as soon as I shall have completed my course at this Institution. I have one remark more to make. During the combustion of the ether, (in the experiment for determining whether water will conduct heat downwards,) the bead of fluid in the stem of the thermometer, did not move until just as the flame of the last lamina was expiring. The bead then commenced moving, and for an instant continued in motion, after which it ceased. This tends to show that radiant heat does not pass freely through ether, as it does through most fluids.

W. M. Mather.

West Point, Sept. 1827.

INTELLIGENCE AND MISCELLANIES.

I. American.

1. Temporary Rudder, *fitted at sea, to the Liverpool Packet Britannia, by her commander*, Charles H. Marshall.—The public papers have recently informed us, of the circumstances which led to the invention of this rudder, and of the great satisfaction expressed by the passengers, in the skill and intrepidity of Captain Marshall, which so soon rescued them from an anxious situation.

Capt. Basil Hall, (so well, and so advantageously known, in both hemispheres,) in a letter to the Editor, dated, New York, Nov. 5, 1827, mentioned this rudder, as "the best thing of the kind he had ever seen," and kindly forwarded a drawing, of which the annexed figure is a copy, intended to exhibit the rudder in its connexion with the ship. Captain Hall's opinion, from his high standing as a nautical as well as scientific man, being a very decisive recommendation of the utility of Captain Marshall's invention—a letter was addressed to the last named gentleman, requesting his permission to make the drawing public, and asking any additional information which might be necessary to elucidate the subject.

The following is his reply:—

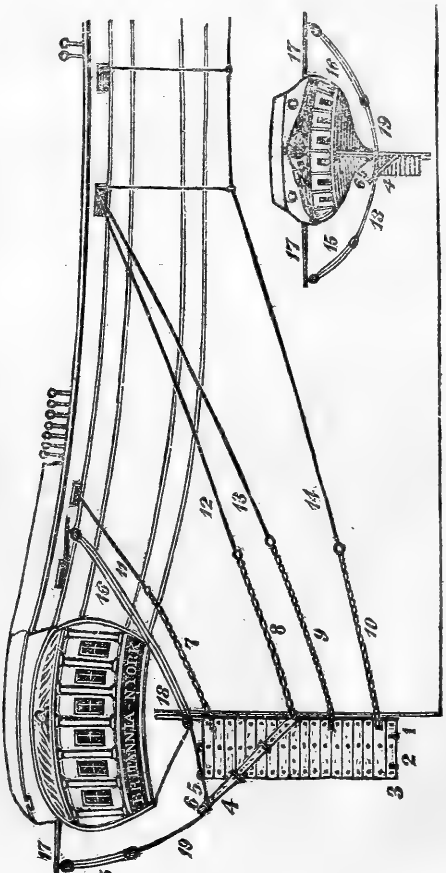
New York, Nov. 15th, 1827.

TO B. SILLIMAN, ESQ.

Dear Sir—I received your letter a few days since, and I can assure you, I feel great pleasure in giving you every possible information respecting the fitting of my temporary rudder, and in order to give you a full idea of its construction, I must beg your acceptance of a wooden model, fac simile, of the original; it has been examined with great interest since my arrival, and I believe pronounced, without a single exception, the best thing of the kind ever adopted. I consider the knowledge of this, so simple, so easily made and requiring so little material, and one that can be shipped in a tolerably moderate sea, particularly valuable to all nautical men. I was not more than twelve or fourteen hours in making it and fitting it to its place, and I found it would stear, wear, and stay the ship with as much ease as the former one. You will observe the piece across the top of the rudder post, that is intended to fit under the carlings of the deck, provided it is necessary to have any thing to keep it down, and if it is necessary to have any thing to sink it down to its place, the end of a chain cable may be used, the end of it being lowered down, between the planks of the rudder; the square piece that is attached, is intended to show the form of the ship's stern post. I trust with the model, and what I have endeavoured to describe here, you will have a clear idea of the work. Should I have omitted any thing that you may wish to know respecting it, I shall always, be happy to confer with you, and as I have not had the pleasure of perusing your Journal, I shall feel myself much flattered in accepting your kind offer of the Number, containing the drawing and description. Respectfully, and sincerely, your obedient serv't.

CHARLES H. MARSHALL.

Two views of a temporary rudder, fitted for the Ship Britannia, by her Capt. C. H. Marshall, on the 18th Oct. 1827, she having lost her rudder, on the 17th Oct. in lat. 45 and lon. 52—twenty three days out from Liverpool, to New York.



REFERENCES.—No. 1. Spare top gallant mast.—Nos. 2 and 3, part of lower studding sail boom.—Nos. 4 and 5, the tiller, two pieces of oak plank, three inches thick, one each side of the above spars.—No. 6. A piece of timber to fit in the outer extremity of Nos. 4 and 5.—Nos. 7, 8, 9, and 10, pieces of chain, say spare mizen top sail sheets, past twice round the rudder post, No. 1, and on which the rudder traverses.—Nos. 11, 12, and 13, parts of a hawser.—No. 14, part of a stream cable, taken in at the hause hole and secured to the windlass.—Nos. 15 and 16, double falls to the ropes.—Nos. 18 and 19, extending from the outer extremity of Nos. 4, 5, and 6, (the lever or *tiller*,) to blocks on the ends of No. 17, a spare top sail yard, and from thence they are led to the *wheel*, as in ordinary cases.

If the drawing and description furnished by Captain Hall, (clear and intelligible as they are,) should leave any thing to be desired, to a perfect understanding of the subject, especially by those not familiar with ships, the Editor will have great pleasure in exhibiting and explaining the model, furnished by Capt. Marshall. It renders the invention and its application, perfectly intelligible, even to mere landsmen.

2. *Miscellaneous notices among the White Mountains and other places, by Prof.* F. Hall.

TO PROFESSOR SILLIMAN.

Sir—If the following localities have not been made public by yourself, or some other individual, I will thank you to insert a notice of them in the "American Journal of Science and Arts." F. Hall.

Beryls occur at Fryeburg, Maine, a few rods from the village, in great abundance and variety. Some of them are four or five inches in length, and from one tenth of an inch, to two inches in diameter. They exhibit the usual color, and form, and articulations of the beryl. This information is derived from Amos J. Cook, Esq. Preceptor of the Academy, in Fryeburg, who had the kindness to furnish me with several beautiful specimens of the mineral, which he had procured fron this locality.

Permit me, Sir, to remark, that in whatever part of our country I travel, I find enterprising and enlightened mineralogists. Twenty-five years have not yet fully elapsed, since total darkness, in relation to mineralogy, brooded over our whole land. Now, light is springing up, and diffusing itself, in every direction. Much of this light has unquestionably, been produced by the lectures* given in Yale College, by the publications from that seminary, and from Professor Cleaveland; much by the exertions of that excellent man, Dr. Bruce, who now rests from his labors, and much by those of that able geologist, William Maclure, the actual President of the American Geological Society. The gentleman last

* If Prof. Hall thinks the efforts that have been made in Yale College, at all important to be mentioned on the present occasion, he would not, we presume, omit to honor the zealous and successful exertions of Dr. J. W. Webster, and Dr. H. H. Hayden, nor the early labors of Dr. Seybert and Dr. Mitchill, and the cabinets formed by, or under the auspices of, the late B. D. Perkins, Mr. Gilmor, the late Dr. Smith, (of Philadelphia,) Dr. Hosack, and Dr. Waterhouse, and more recently, by many other gentlemen.

named, planted the seeds of this science at Fryeburg. He imparted to the Principal of the Academy, Mr. Cook, a taste for this useful branch of natural history. He transmitted to him a few specimens of foreign minerals, which have served as a nucleus, around which are now assembled six or eight hundred, and, perhaps, a thousand elegant American specimens. These are systematically arranged, and occupy, and adorn, an upper apartment in the academical edifice.

Amethyst, of a delicate purple color, in hexagonal prisms, is found near the bottom of an avalanche, occasioned by the flood of 1826, a mile above the elder Crawford's, on the Saco river. The crystals are of very different magnitudes; the smallest being the most perfect. Some of them are white and transparent, like quartz, and terminated at one extremity, by six sided pyramids of the richest amethyst.

Smoky quartz occurs at the same locality, crystallized and massive. At this spot, the mineralogical traveller will delight to linger some hours. It is the only spot, known to me, on, or near the White Hills, where specimens of much interest have been found. A large mass may be seen, in Crawford's bar-room, constituted chiefly of the two minerals, amethyst and crystallized smoky quartz.

Most of the country between Portland and these mountains, is extremely rocky, but the soil is good, yielding large crops of grass and grain. The rocks are principally granite, which, in a number of townships, is wrought and employed as a building stone. The Unitarian Church in Portland is constructed of this stone, obtained by means of wedges, and not hewn. It is a noble edifice.

The object which monopolizes, and rivets to itself, the attention of the stranger, as he passes up the valley of the Saco, is the desolation, produced by the deluge, on that awful night of August 28, 1826. The windows of heaven were then literally opened wide, and in a sad moment the full contents of the sky exhausted on this loftiest and wildest portion of our country. Traces of the disastrous effects of the mountain torrent are visible on the borders of the Saco, in several places in the township of Conway, and even below; but they become remarkably striking on arriving at Crawford's inn, situated on a tract of land, called Hart's location. His farm is nearly ruined; its most productive soil is all swept away, and gone to enrich the lands below; lands whose increased fertility is evinced by the unusually abundant crops, with which they are loaded the present season.

East of Crawford's, and in his immediate vicinity, stands an enormous spur of the White Hills, whose summit towers, I conjecture, to the height of two thousand feet above the bed of the stream, that laves its base. This spur is in the form of a crescent, perhaps two miles in extent, bending its arms to the west. The higher regions of the mountain yield nothing but a stinted growth of shrubs and briars, and lichens; towards the bottom it is skirted with full sized forest trees. The western area of this mighty protuberance is thickly striped, from top to bottom, with wide channels formed by the water, rushing from the mountain, and bringing with it immense quantities of earth, shrubs and stones, some of which weigh fifty tons, and leaving, in most instances, nothing in its track but the solid granite, of which these mountainous regions are almost entirely composed, laid bare to the light of heaven.

Here, the traveller begins to imagine himself in the midst of the mountains of Switzerland. Every thing he sees is Alpine. The White Hills are more rugged, and precipitous, and loftier;—they excite bolder ideas of the sublime in nature, than any other American mountains, east of the Mississippi.

Proceeding up the Saco, you are barricaded on both sides of the road, by chains of mountains, rising to an astonishing elevation, which are all striped, in a manner somewhat similar to the one already described.

I ought here to state, for the benefit of those, who may not be acquainted with the fact, that there are two Crawford's—the father, and the son—who keep public houses, the former at the foot of the mountain, in Hart's location, and the latter, on the highest land, over which the road passes, and which this gentleman supposes to be the most elevated land, inhabited in the United States. This farm is the one, which, when Dr. Dwight gave the world his beautiful description of the White Mountains, was owned and occupied, by "old Mr. Rosebrook"—the father of the person, of the same name, who keeps a tavern, a few miles to the north of Crawford's. These two men, the Crawford's, are situated twelve miles apart, and there is at present, no human dweller between them. The road from one house to the other, and indeed, over the whole distance from Conway to Littleton, is badly repaired, and excessively rough, passable in strong waggons, in which the mail is conveyed, but not in coaches.

Six miles above the elder Crawford's, stands on the left of the road, the Willey house—a melancholy spectacle. No voice of man, or child, or dog is heard at the stranger's approach. All is still as the rocks around it; its owner, and all its occupants, having been swept from the land of the living by a fatal avalanche, and buried under it. The tale of this shocking event has been told, better than I can tell it, all over the civilized world, and it would be useless to repeat it. I will only say, that an immense mass of matter—liquid and solid—rushing from the mountain, west of the house, menacing with destruction, every thing that lay in its way, was separated, two or three rods before it reached the dwelling, by the hand of Him, "who rideth upon the wings of the wind and directeth the storm," into two branches, the one passing to the south, and the other to the north, leaving the house uninjured, in the angle between them.

Standing at the younger Crawford's, and casting your gaze around the ridgy horizon, surveying the wildness of nature's works, your eye is attracted to the south-east, by a vast pyramid, that mocks, and holds in utter contempt, those of Egypt—raising its majestic summit among the clouds:—it is "a tower, whose top reacheth unto heaven." When I saw it first, from this spot, the last beams of light, from a bright setting sun, were falling fast upon it, which, being reflected, with diminished, and softened lustre, presented the object before me, clothed with inexpressible beauty and grandeur. Light and shade were sporting on its front. The dark shadows of the opposite hills and mountains were slowly travelling up its rugged cliffs, and vanishing in thin air. But soon clouds and darkness concealed it from my vision. This is mount Washington. Its distance from Crawford's is nine miles. Three miles of this, can now be travelled with safety, and some comfort, on horse-back, and even in strong vehicles. This road has recently been made, by Mr. Crawford, who designs to extend it to the foot of the mountain, three miles further, the present summer.

Schorl, in small, imperfect crystals, thickly interspersed in granite, occurs on the very pinnacle of mount Washington. The mica, contained in the granite, is distinctly foliated, and has the whiteness, and lustre of silver.

3. Mr. Genet's *Remarks on Dr. Jones' Animadversions.*

TO THE EDITOR.

New York, August 30, 1827.

Sir—Through the kindness of your printer, I have received a proof sheet of Dr. Jones' (I am ashamed to repeat it, for the honor of philosophy,) *animadversions* on my memorial on the upward forces of fluids, and if it is not too late*, I hope that these few lines will also find, in the same number of your Journal, where those appalling *animadversions* will appear, the following humble and short rejoinder, namely; that being satisfied that in experimental philosophy and practical mechanics, results and facts are the best means of settling points in dispute, I have cultivated, since last fall, in this city, the friendship of philanthropic philosophers, whose pleasure consists in encouraging whatever may eventually be useful; of liberal citizens, who are always willing to promote the arts, of good hearted mathematicians, who like better to rectify than to rebuke, and of able and public spirited mechanics, whose experience is a sure guide; and that owing to those favorable circumstances, and an elaborate investigation of whatever, in the science of mechanics, has any connexion with my plans, I have very much improved my mechanical combinations, for the navigation of the air and water by hydrostatic and aerostatic forces. I shall, in a few days, Sir, be able to make experiments that will attest, 1st, the available power of hydrostatic pressure, and aerostatic levity to propel boats or vessels, deducting all friction and resistance, and 2nd. the additional advantages of a pump totally different from those that I had at first contemplated, that will double instead of diminishing my powers. I have been also preparing a system of machinery very much simplified, to steer the aeronauts in favorable currents, and endow them with the faculty of raising and lowering themselves by inclined planes, into more favorable strata, if they meet adverse ones; and when my friend Eugene Robertson, whom I expect every day, is arrived, we shall be able to begin progressively, according to our means, our aerostatic experiments in a fort of this city, which, under the auspices of our general government solicited by Mr. Clinton, governor of this State, has been de-

* The number containing Dr. Jones' animadversions was already finished when this letter arrived.—Ed.

signated for that purpose. The spacious and circular yard of that fort, called, after the late general Gansevoort, and the adjoining buildings, will become an excellent laboratory, and school of aerostation. In the mean while, Dr. Jones, may animadvert as much as he pleases, he may rest assured that I shall not take the trouble of answering his lucubrations, following in that respect, the example of Montgolfier, who, when he published his discovery of the balloons and his contemplated experiments, was assailed from all quarters, with the most scientific dissertations, attempting to prove by all the rules of mathematics, and the formulas of algebra, that he would fail. I am, I confess, more than ever sanguine in my expectations, but if I am disappointed, you will I know, Sir, be one of those who will say, as of the unfortunate Phaeton, *Magnis tamen excidit Ausis.*

Respectfully yours, E. C. GENET.

4. *Proceedings of the Lyceum of Natural History, N. York.*

January, 1827.—A communication was read by the Secretary on the *Sorghum saccharatum*, as an important material to be employed in the manufacture of hats. The author was requested to give publicity to his communication.

Mr. Bull presented a valuable series of specimens illustrating the Lehigh coal formation, and announced his intention of presenting a detailed memoir, on the subject at a future meeting. The same gentleman presented fossil ferns, and a new and very remarkable variety of pulverulent talc from the above locality.

Major Delafield, presented a remarkable specimen of native magnet, from Warwick, Orange county, and of spinelle in calc. spar from Amity, Orange co. of the variety called ceylanite.

The Prince of Musignano read a continuation of his Synopsis of the genera of American birds.

Mr. Barnes communicated a paper on several rare and new species of mollusca.

February.—Mr. Barnes presented five varieties of clay from the vicinity of Augusta, Geo. one of these a very fine white clay, is from the locality called chalk hills, and is supposed there to be properly a chalk.

Major Delafield announced the discovery of the alcyonium, in a green sand formation, near Annapolis Maryland, and exhibited the fossil. The same gentleman presented a valuable collection of European and American minerals; among the latter were beautiful specimens from Warwick, Orange co. N. Y. of massive brown and yellow brucite, granular do. large crystals of a new ore of titanium, with spinelle pleonaste in brucite and serpentine. Large terminated crystals of hornblende; gray spinelle with brown brucite, and *purple fluate of lime.*

A paper was read by Dr. De Kay on the *Lepidopus caudatus*, from the coast of North America, presented by Captain Fowler, with a description by Dr. Mitchill, of a new species of cod fish, from our waters. The *gadus atro-marginatus* formerly described as the *ophidium barbatum.*

The following officers were elected at the anniversary meeting of the Society.

Joseph Delafield, *President.*
Abraham Halsey, } *Vice Presidents.*
James E. De Kay, }
Jer. Van Rensselaer, *Corresponding Secretary.*
J. S. Graves, *Recording Secretary.*

March.—Major Delafield presented a suite of thirty specimens from Easton, Pennsylvania, illustrating the mineralogy of that interesting region. They consisted principally of choice specimens of the talcose and serpentine rocks, with their accompanying magnesian minerals. He, at the same time, exhibited the *crystalized serpentine* of that locality, and intimated a belief that the crystals were not pseudomorphous.

Capt. LeConte communicated a paper entitled observations on the American plants of the genus tillandsia with descriptions of three new species; and another paper describing a new species of Siren, the *S. intermedia.* See An. Lyc. Vol. 2.

A communication was received from Dr. De Kay, respecting the lower jaw bone of a Mastodon, recently found at the falls of the White river, Indiana.

A box of bituminous coal was presented by governor Clinton, from Pennsylvania, about twenty miles from Newton, Cayuga county, N. Y.

Mr. Peale, of the Parthenon Museum, exhibited a small fresh water, double headed tortoise, in a living state. It appeared to be the young of the *T. Muhlenbergii*, or *T. biguttata* of Say.

A superb copy of Ruiz and Pavons' Flora Peruviana, in three folio volumes, and other rare and valuable works on Natural History, were presented by Dr. David Hosack of this city.

A paper was read by the Prince of Musignano, describing several species of birds, recently added by him to the Ornithology of the United States.

Dr. Mitchill communicated a paper entitled observations on the *Lythrum verticillatum*, popularly known as loose strife, milk-willow-weed, &c. Many facts were stated exhibiting its deleterious effects upon parturient animals.

April.—A letter was read from Dr. Woodbury, a corresponding member, now in the city of Mexico, accompanied by a box of clover seed, of a peculiar species. It is said to grow to the height of four feet in twenty or thirty days.

Mr. Cooper reported on the large serpent, recently exhibited alive, in this city, as the *Boa constrictor*. It was obtained from Batavia, and Mr. C. regarded it as the *Python tygris*, the rock snake of the English residents at Batavia. Mr. C. presented, at the same time, prepared specimens of the tibia of this animal, illustrating the recent discoveries made by Mayer, of Bonn, that many serpents are provided with feet, although they exist only in a rudimentary state.

Professor Dana offered precious garnet from Hanover, New Hampshire.

A paper was read by Dr. Torrey on several new plants collected by Dr. James, from the Rocky mountains.

Major Delafield offered, for inspection, crystalized brucite, from Franklin, N. J. This specimen was interesting, as some foreign mineralogists have doubted whether it ever occurs in this form. The specimen exhibited, is conclusive on this point. The same gentleman also exhibited crystals of *sapphire*, from Newton, Sussex county, N. J.

Prof. J. A. Smith announced his intention of delivering a course of lectures on comparative anatomy, before the society.

Prof. Dana read an account of some experiments on the *Sanguinaria Canadensis*, from which he had obtained a peculiar vegetable principle, termed by him *Sanguinarina.* He suggests that the coloring matter of the root is a peculiar alkaline salt. The paper was referred to the committee of publication. See An. Lyc. Vol. 2.

The same gentleman presented a large mass of sulphuret of copper from Franconia, Vt. He communicated an analysis of this substance, with remarks on *Pyritous copper.* Referred to the committee of publication. See An. Lyc. Vol. 2.

5. *Tioga Coal.*—The following additional facts, respecting the Tioga bituminous coal are furnished to us, by Dr. T. Romeyn Beck, of Albany, who read a paper on its topography and analysis, before the Albany Institute in the winter of 1824–5. "It is found at and near the head of the south branch of the Tioga river, in the town of Covington, Wayne county, Pennsylvania, and about thirty miles south from Painted Post, and fifty miles southwest from Elmira, (both in Tioga county,) in the State of New York, following the course of the river. It was first discovered about the year 1796, by a Mr. Benjamin Patterson, while crossing the country with a party of German emigrants. In the course of a hunting excursion, he found the coal on the top of a hill, where the wind had blown over trees by the roots.

The abundance of wood in this district of country has, until late years, prevented much attention to it. Blacksmiths, in the immediate vicinity, have, however used it for some time.

The quantity of carbon obtained, in several experiments, was rather larger than that stated by Dr. Meade.

While making these experiments, it was deemed worthy of examination, whether the Tioga coal was calculated for the production of carburetted hydrogen. An ounce in powder was put into a stone ware retort, and the heat of a portable furnace applied. Gas soon came over, which had the peculiar smell of carburetted hydrogen, when obtained from bituminous coal, although there was less of petroleum floating on the surface of the water than is usually observed. The gas was passed through water, *not lime water*, and hence its impurities were not removed. We had obtained two gallons and upwards, when the process was stopped. It burnt with a yellow flame, occasionally mixed with blue, the latter doubtless being *carbonic oxide.* Works on chemistry mention that one pound of coal will furnish twenty gallons of coal gas.

When passed through lime water, its flame could not be distinguished from that of carburetted hidrogen, made in the common way. Both however yielded in brilliancy to the natural carburetted hidrogen, which is generated in such abundant quantities in Chatauque county, on the borders of Lake Erie, and with a quantity of which I was favored by several friends residing in that vicinity.

No doubt can exist of the Tioga coal becoming a satisfactory substitute for European coal, whenever the projected water communication shall render its transportation sufficiently cheap and convenient."

6. Water Cement of Southington, Conn. *communicated by* Mr. Thomas Lowrey, *at the request of* Mr. Sheldon Moore.—The hydraulic lime stone of Southington, is found about two and a half miles east of the turnpike road, in Southington, and directly east of the meeting house. The stone is of a blueish grey cast, veined with thin continuous layers of slate, nearly devoid of lime. It is found near the surface of the earth, and is remarkable in having a southerly dip, or inclination of about fifteen degrees, while the strata of slate and secondary rocks in general, incline nearly as much in a north east direction. The quantity of it is doubtless inexhaustible. The operations of manufacturing it are simple, though attended with considerable labor, and some expense for fuel. The stone is burnt in a common kiln, like quick lime, and requires about the same burning ; it is next ground fine with mill stones, and is then ready for use. The mode of using it, and mixing the mortar is as follows :—Take about two parts of sand and one of cement and form it into mortar, somewhat thinner than quick lime mortar. If the sand is not good, equal parts of sand and cement should be used. If the situation in which it is employed will admit of its having a short time to dry, before water is admitted to it, it will sooner become firm and secure. But it will set, if exposed to water immediately, provided it has sufficient consistency, not to be carried away by the water. The uses to which it is applied are various. In addition to its use in the construction of canals, it has been employed for mill dams, cisterns, cellar walls, vats, and all kinds of mason work, exposed to water. It has been used, in several instances, for the outside walls of wood houses, and in some instances, for the

roofs of houses. Its quality is believed to be equal to that of the cements manufactured in the State of New York, for canal, and similar purposes. It has been used in the construction of the aqueducts and culverts on the Farmington canal, and the engineer, and those who superintend the works on that canal recommend it as being of a good quality.

7. *Southern Review.*—We have received the Prospectus of a Southern Quarterly Review, to be published at Charleston, South Carolina, and to commence on the first of February. Judging from our knowledge of the source whence this plan derives its origin, we cannot doubt, that the work will be sustained with talent, learning and industry; and that it will be a source of honor and advantage to the southern states, and contribute to the stock of mental and moral power which constitutes the most important item in our national wealth. We wish the Southern Review ample success. Each number will contain about two hundred and fifty pages, and the price will be five dollars per annum. Orders for the work may be sent to A. E. Miller, Charleston, S. C.

8. *Annunciation of the second part of Professor* A. Eaton's *Report of the Geological survey on the Erie Canal.*

Professor Eaton having collected the materials for the second part of the Erie canal survey, which was made at the expense of the Hon. Stephen Van Rensselaer, its publication will soon commence in this Journal; and a few pages of each number will be devoted to it until the whole is completed.*

Prof. E's views of geological nomenclature, founded on his own examinations, and on those of his colleagues and assistants, will appear first. He thinks he has made several discoveries, and detected some errors, since the publication of the first part. Particularly in the argillite, sparry limerock, graywacke, calciferous slate, pyritiferous rock, and old red sand stone. He wishes the following tabular view to be presented to the scientific public for criticism. Any suggestions communicated to him at Troy, New York, before the middle of next February, will be thankfully received by him.

In this tabular view, the superincumbent, or basaltic rocks, and alluvial formations, are omitted. The particular locali-

* After it is completed in this Journal, it is to appear in the form of the first part, that the whole may be bound up in one volume.

ties upon which Mr. E. relies for the support of his views, will be carefully described, so that any one will be enabled to judge of his accuracy.

TABULAR VIEW OF NORTH AMERICAN ROCKS.

General Strata.	*Subordinate rocks.*	*Varieties.*	*Principal Beds.*
		PRIMITIVE CLASS.	
I. Granite,	Crystalline,	Graphic,	Diallage.
	Slaty (gneiss,)	Porphyritic,	Steatite.
		Sandy,	
II. Mica-slate,		Fissile,	
		Compact,	
III. Hornblende rocks,	Granitic,		
	Gneissoid,		Augite.
	Slaty,	Green,	
	Sienitic,	Porphyritic,	
IV. Talcose slate,	Chloritic,		
V. Granular quartz.		Opake,	
		Translucent,	
VI. Granular lime-rock.	Statuary marble,	White,	
	Slaty,	Variegated.	
		TRANSITION CLASS.	
VII. Argillite,	Roof-slate,	Shining,	
		Purple,	
		Red,	
		Earthy,	Calciferous sand-rock.
	Glazed slate,		
	Flinty slate,	Jaspery,	Striated quartz.
VIII. First gray-wacke,	Inclined,	Chloritic,	
	Rubblestone,	Chloritic,	
IX. Sparry lime-rock,		Slaty,	
		Compact,	
X. Calciferous sand rock,		Sparry,	
		Geodiferous,	Semi-opal.
XI. Metalliferous limerock,	Compact,	Birdseye marble,	
	Shelly,		
XII. Second gray-wacke,	Horizontal,	Red sandstone,	
		(old red sandstone)	
		Grey sandstone,	
		Argillaceous,	Anthracite.
	Rubblestone,		
		SECONDARY CLASS.	
XIII. Millstone grit,		Sandy,	
		Conglomerate,	
	Red, (variegated,)	(breccia,)	
XIV. Saliferous rock,		Sandy,	
	Grey (greyband,)	Marly slate,	
		Sandy,	
		Marly slate,	
XV. Ferriferous slate,		Green,	Argillaceous, iron ore.
		Blue,	
XVI. Ferriferous sandrock,		Compact,	Argillaceous, iron ore.
		Gravelly,	
XVII. Lias,	Calciferous slate,		Gypsum,

General strata.	*Subordinate rocks.*	*Varieties.*	*Principal Beds.*
	Conchoidal slate, Oolitic limestone,		Shell limestone.
XVIII. Geodiferous limerock,		Fetid, Sandy,	
XIX. Cornitiferous limerock,			Hornstone.
XX. Third graywacke,	Pyritiferous slate, Red sand (old red sandstone ?)		Bituminous shells and coal.
XXI. Pyritiferous grit,	Grey sandy, Argillaceous, Calcareous, Conglomerate, (breccia,)		Hornstone ?

9. *New Haven Gymnasium.*—The great importance of this undertaking, its close connexion with the interests of learning, the high standing and eminent qualifications of the gentlemen concerned, the happy location, the ample accommodations of the buildings, and the deep interest of the community in the success of the enterprise, have induced us to insert, not a mere notice, but the entire prospectus of the institution.—Editor.

Prospectus of the New Haven Gymnasium; a School for the education of Boys, to be established at New Haven, Conn.; by Sereno E. Dwight *and* Henry E. Dwight.

We propose in the ensuing spring, to establish, at New Haven, a school for the education of boys; and, have engaged the large and commodious building, originally intended as a steam-boat hotel, with the adjacent grounds. The house is one mile from the college, and three fourths of a mile from the centre of the town; and commands a fine view of the New Haven valley, and the surrounding mountains, of the harbor, the Sound, and Long Island.

New Haven, as a place of moderate size and great salubrity, as distinguished for the beauty of its site and environs, the neatness of its buildings and grounds, and the richness of its foliage, and as presenting a state of society in a high degree moral, enlightened and polished, is a favoured seat of education. It is within eight hours travel from New York, and within less than twenty-four from Boston, Albany, and Philadelphia, and has a direct communication with every part of the United States.

The proposed institution, in its general plan, is intended to resemble the Round Hill School, at Northampton; the proprietors of which, for having introduced the *Gymnasium* into this country with so much talent and success, deserve the thanks of the friends of literature; as they do ours also, for the frankness and cordiality with which they have seconded our design.

We propose, with the boys, to occupy the house as a family, to take the entire charge of them, and to stand in the place of their parents. The government of the institution will be at once strict and parental. The boys, unless on special occasions, will not be allowed to leave the grounds, except in company with a teacher or guardian. They will be permitted to contract no debt, and to make no purchases for themselves. It is intended to have them always, in effect, under our own eye, and to fill up their time with study and useful recreation.

Wishing to form the character from an early period, and not to be responsible for habits and a character formed elsewhere, we propose to receive boys of the age of *six*, and to decline (unless in peculiar cases) commencing with any after the age of *fourteen.*

A part of each day is to be regularly devoted to Gymnastic exercises. These, with other active employments, are the best means of preserving the health, and invigorating the constitution. Assiduous attention will be paid to the subject of Manners.

As some boys are designed for college, and others are not, the course of education will be accommodated, in each case, to the wishes of the parent. Both classes of boys will need instruction in Spelling, Reading, Writing and Drawing, in Declamation and Composition, in Arithmetic and Algebra. Geography, with the aid of the best books, of maps, charts, and globes, is to be pursued as an object of prime importance. Both will also study French, Spanish, German and Italian under *native* teachers: and for this end measures have been taken to procure the assistance of gentlemen of acknowledged talents and character.

The boys preparing for college will likewise be taught Latin, and Greek, with the elements of History, and where it is wished the Hebrew.

The boys not intended for college will, in addition to the above, be taught Latin if the parents consent, English Grammar, Rhetoric, and as extensive a course of Mathematics as is desired. They will have the opportunity to receive a regular course of instruction in Botany, History, Logic, Ethics, Mental Philosophy and Political Economy. It is expected also, that, those students, who have been sufficiently long in a course of education, and have made the requisite attainments, will be permitted to attend the course of Lectures on Chemistry, Mineralogy, and Geology, by Professor SILLIMAN ; and the course on Natural Philosophy and Astronomy, by Professor OLMSTED.

The religious instruction of the pupils will be parental. The great aim will be to train them up in the fear of God. Each day will begin and end with reading the scriptures and prayer. The Bible will be a class-book on the sabbath ; and the pupils will attend church at the place designated by their parents.

This is our general plan: we shall aim to execute it with fidelity ; reserving, however, the right of making such alterations as experience shall show to be necessary. With the subject of education, we are not wholly unacquainted. One of us has been occupied for a considerable period, in a course of collegiate instruction. Both of us have had the privilege of surveying many of the principal seminaries of Europe ; and one of us, during a long residence in Germany, has examined, with the utmost attention and care, the system of education pursued in several of her Universities, and in her Academic and Commercial Gymnasia.

There will be two vacations in the year, each of three weeks ; the first to commence on the first Wednesday of May ; the other on the second Wednesday of September. During both, the boys may remain at the school without additional expense.

We shall have a valuable library of the best authors in English, Latin, Greek, French, Spanish, Italian, and German.

The annual charge for boys of ten years and over is three hundred dollars ; but a deduction will be made where two or more come from one family, at the same time. The charge for boys under ten is two hundred and fifty dollars. In this sum are comprized all charges for instruction, including the tickets for the college lectures, board, washing and mending, room, fuel, lights, and furniture, except a bed or mattress, and bedclothing, to be furnished by the pupil. These may be procured on the spot, at a fair price. Where it is wished, the clothing of the boys can be procured by us, and on terms advantageous to the parent.

It is intended to open the institution on the 1st of May, 1828.

SERENO E. DWIGHT,
HENRY E. DWIGHT.

New Haven, Nov. 28, 1827.

10. *Protest against the admission of a power of fascination in Snakes.*

TO PROFESSOR SILLIMAN.

West Chester, *Penn. August* 4, 1827.

Sir—I was rather surprised to observe an article, in the last number of the American Journal of Science and Arts, (Vol. xii. page 368,) which speaks of the supposed *fascinating power of snakes*, as though it were an established fact. The writer professes to be "convinced by ocular demonstration;" and yet, so differently do men view occurrences of a similar character,—I have witnessed cases fully as much in point, and I think even stronger than the one there related, which "convinced" *me*, that the notion of a fascinating power, in those animals is an utter fallacy, and delusion. I had supposed, indeed, that the doctrine, (so far as intelligent, cautious observers of the phenomena of natural history were concerned,) had long since descended to the "tomb of the Capulets," together with the kindred belief, that certain aged and ill-favored females, of our own species, were also endowed with the power of incantation. At all events, I think those who undertake, at this time of day, to demonstrate the existence of such a power, in serpents, ought at least to furnish cases in which the process was *consummated;* and not content themselves, as they almost invariably do, with relating instances in which the operation was interrupted by some accident, or interference. Such evidence I consider very inadequate to the establishment of so extraordinary a process as that which is understood by *fascination.*

In the numerous cases which I have heard related, something always occurred to *break the charm;* and the excited feelings of the observer enabled him to *imagine* the catastrophe that was *about to happen!* Testimony of this description can never satisfy a mind that is not strongly predisposed to an implicit faith in the marvellous.

What is there in the eyes of a snake, more than in those of a cat, by which birds may be *fascinated?* Birds will flutter and hover round both these relentless enemies, at certain seasons and do often fall victims to the wiles and dexterity of both: but to assert that there is a magic influence by which they are attracted into the jaws of a known enemy, is an attempt to tax our credulity rather too severely, for the present condition of science. The artifices of birds, to decoy unwelcome visiters from their nests, are oftentimes very remarkable. I have seen them simulate lameness, and flutter about as though they were much crippled, evidently for the purpose of attracting attention, and drawing the visiter in pursuit of *themselves*, in order to save their tender young. Indeed, their extraordinary manœuvres, on such occasions, might readily be mistaken, *by a believer in fascination*, for the effect of some such imaginary power. That the same artifices are employed by the feathered tribes to divert snakes, cats, and all other intruders, known, or supposed to be dangerous, from the neighborhood of their nests, there can be little doubt.

The grave tales, however, which are related of snakes *charming* birds, drawing squirrels down from tree tops, and even subjecting human beings to their incantations, are so entirely foreign to all my ideas of rationality, and so inconsistent with all my own observations, that I am fully prepared to reply to such representations, in the language of the Roman Poet:—

"*Quodcunque ostendis mihi sic, incredulus odi.*"

I do not deem it necessary to detail my reasons, *in extenso*, for disbelieving what I am convinced is a vulgar error. I should as soon think of troubling you with a series of arguments against the doctrines of *water smelling* or *witchcraft*. It is for those who contend for the facts, to furnish conclusive evidence of their existence. The actual state of natural science, requires that substantial proof be afforded, to induce a belief of improbable things. My only object, in this hasty notice of the matter, is to enter my humble protest against such a doctrine passing to the world through an "American Journal of Science," without something like *satisfactory* evidence of its correctness. W. D.

The preceding article was intended for the former number of this Journal, but arrived too late for insertion. The very respectable author has, by fair implication, conceded in his denial and *rebuke*, all that any sensible man probably believes on the subject; that is to say, that by terror or by engrossment of the faculties in some other way, one animal has it sometimes, in his power, to place another animal off his guard, and to bring him within his reach, so that he thus becomes his prey; just as a child, or even a botanist, *fascinated* by the beauty of flowers and plants, may so far forget his safety, as to venture too near to the edge of a precipice, till an unconscious movement precipitates him fatally to the rocky bottom, or into a watery abyss. This is, (at least figuratively,) *fascination*, but it is not *witchcraft*, and it was all that was intended by the case stated by us, in support of the communication on the *so called*, fascinating power of snakes.—Editor.

11.—*New work on Ichthyology.*—Proposals for publishing by subscription, a work on the Fish of North America, with plates, drawn and colored from nature, by C. A. Lesueur. This work will be published at New Harmony, Indiana, in numbers, with four colored plates in each, and the necessary letter-press containing the descriptions of the species represented. Twelve numbers will constitute a volume. Messrs. Tiebout, and other artists from Philadelphia, who were there occupied on the "American Entomology," are engaged for this work. Books with colored plates, are generally beyond the reach of persons of limited means; but it is intended, that the present work shall be adapted to the circumstances of all. The price to subscribers will therefore be forty cents each number.

Subscriptions for the above work may be sent in to the Editor of this Journal, who will be furnished with copies to supply all the subscribers whose names may be sent to him, and he is authorized to receive the subscription money for the publishers.

The scientific and graphic skill of Mr. Lesueur are so well known, that any recommendation is superfluous. It must however appear to all persons interested in natural history very desirable to obtain faithful copies from nature, with accurate descriptions for so small a sum, as the expense of colored engravings of natural objects is generally so great that they are beyond the reach of all, except the wealthy. The present work would have cost six times as much in France, and eight times as much in England.

Dog Train of the North-west

A.Doolittle sc.

12. Dog Trains of the North West—with a Print.

Extract of a Letter from Dr. Lyman Foot, *from Cantonment Brady, Sault St. Marie, Lake Superior, to the Editor.*

Thinking it might be some amusement to you, to see the mode of travelling in the Northwest, *Mrs. Foot*, has sketched a dog train, which I enclose you. Three dogs will carry a man and his provisions. The traders travel all over the wilderness with them, over unbeaten snow, generally following the course of rivers.

As night approaches, the traveller seeks a thicket, to protect him as much as possible from the wind. He then digs an elliptical hole in the snow, with a snow shoe, at one end of which a fire is built. The bottom is covered with evergreen boughs, on which he spreads a blanket, and wraps himself up, with his feet to the fire. If the night is stormy, large evergreen boughs are placed across the hole, supported by the walls of snow on each side. Thus the traveller and his dogs sleep comfortably, in the coldest weather.

A more particular notice contained in a letter from Dr. Foot, to the Editor is subjoined:—

The dogs are easily trained to turn, halt, and go by word of command. The whip is only meant to crack at them or give any one of them a severe whipping if he is obstinate. When the traveller wishes his dogs to turn to the left, he says " chuck," or " chuch," and cracks his little whip on the right side of his train; if to the right he says "ge," and cracks it on the left side. When they wish them to start or quicken their gate, he says " march," or " avance;" (*avancez*,) when they wish to turn short about, they most commonly get out, or put one foot out, slew the train partly round and say, " vena isse," (*venez ici*,) or as the Canadians pronounce it " vena issit," making a motion with the little whip at the same time. It is astonishing to see with what facility dogs are taught and managed. I own a train of dogs, one of which I broke myself. They are a great amusement to me in winter. I frequently ride over the river, and a mile or two round for amusement, and have, with three dogs, taken my wife and little boy a mile, to make calls on a genteel family, over the river, (a Mr. Erwatingen,) who has resided here ten years, carrying on the fur trade.

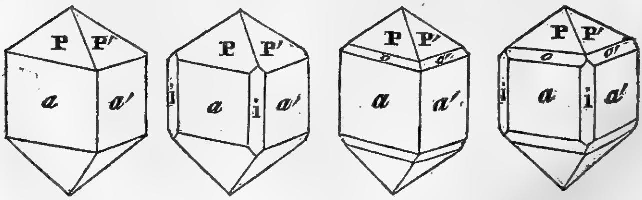
As to the traveller's sleeping, you will hardly believe what I tell you. Those who travel with trains, think no more of sleeping in the woods, in the coldest nights, than you would of sleeping on your dining room carpet. There is a little management necessary, however. They first endeavor to select a thicket: they next dig away the snow to the ground, with a snow shoe, which they always carry, and build a large fire. They then (after boiling their chocolate, &c. &c.) cover a spot close to the fire, with some small boughs of evergreens, such as hemlock or spruce, and if it storms, raise a little covering of evergreens over them, a little resembling a rural cot. There, with two blankets, they will lie down by their fire, dogs and all, and sleep comfortably all night.

13. *Measurements of Crystals of Zircon, from Buncomb, North Carolina; by* CHARLES U. SHEPARD.

The Zircon, of whose crystals are subjoined figures, was discovered in 1820, by Dr. T. D. Porter, and described in Vol. iii, p. 229, of this Journal. It is so interesting from the unusual dimensions, and perfection of form, possessed by its crystals, that I am persuaded a more particular account of it will not be unacceptable, and may be of use in leading some mineralogist to explore a locality which has been too much neglected, for one, which promises to be so peculiarly rich.

Dr. P. does not mention whether the Zircon is found imbedded or detached; but as all the specimens furnished by him, to the Yale College cabinet are loose, and as some of them present rounded angles, and occasionally have their cavities occupied by a soft decomposing feldspar, it appears probable, that they might have occurred in an alluvial situation, agreeably to the manner in which they are found in other countries. The fine lustre of the crystals enabled me to avail myself of the use of the reflective goniometer in determining the value of their angles.

1 2 3 4



P on P, or P′ on P′ over the summit -	95° 30′
—— *a* - - - - -	132 15
—— *o* - - - - -	162
o — *a* - - - - -	152
a — *i* - - - -	135

These figures embrace all the modifications possessed by the collection sent hither by Dr. P. with the exception of a crystal, in which, one of the solid angles formed by the meeting of the prism with the pyramid, was replaced by a single plane, whose inclination to the adjacent planes, it was impossible to ascertain, owing to its smallness and want of lustre. The beautiful form, fig. 1, appears to be the most abundant modification of this locality. In some cases, the prism intervening between the two pyramids is not so long as is represented in the annexed diagrams, and rarely, it is so short, as to bring the bases of the pyramids nearly into contact.

II. *Foreign Literature and Science, extracted and translated by* Prof. J. Griscom.

1. *Remedy against the dangers of the inspiration of Chlorine.*—M. Kastner has advised liquid ammonia on sugar. The following method is of certain efficacy; it consists in breathing the vapor of spirits of wine, or in swallowing lumps of sugar, steeped in alcohol.—*Annales des Mines, prem. Liv.* 1827.

2. *Chemical researches on Starch, by* J. B. Caventon.—Starch is insoluble in cold water; it forms with boiling water what is called, (in French,) *empois.* I distinguish two kinds of empois: 1, that which contains the least starch, (minimum d'amidon,) and which is entirely transparent, and soluble in cold water; 2, that which contains the most starch, (maximum d'amidon,) which is almost entirely opaque, because it contains starch in suspension. Starch, rendered soluble in cold water, is modified in its properties; it is the *amidine* of M. de Saussure; its characters are solubility in cold water, and the property of acquiring a blue color by Iodine.

If a solution of starch is boiled for a long time, it assumes with Iodine, a purplish color. Starch may be brought immediately to the same condition, either by a strong torrefaction, or by heating it with sulphuric acid, diluted with twelve times its weight of water.

If a hot solution of starch be left to itself, during some weeks in the heat of summer, it becomes sour; and if it be then diluted with water, and filtered, the liquor becomes colored with iodine of a purple, while on the contrary, the insoluble part acquires a blue color.—*Idem.*

3. *Specific heat of the gases.*—A memoir on this subject, so important in all theoretical discussions upon the physiology of respiration and animal heat, by AUG. DE LA RIVE and F. MARCET, was read before the "Société de physique et d'histoire naturelle" of Geneva, on the 19th of May, 1827. After a statement of the difficulties attendant on the practical investigation of the question, and the sources of fallacy which they conceive interfered with the results of their predecessors, and especially with those of *De La Roche* and *Berard*, the authors explain their procedure, and arrive at the following conclusions.

"1. That under the same pressure, and in equal and constant volumes, all gases have the same specific heat.

2. That all other circumstances being the same, the specific heat diminishes, cotemporaneously with the pressure, and in an equal degree in all the gases, following a progression slightly convergent and in a ratio much less than that of the pressure.

3. That each gas has a different conducting power; in other words, all gases have not the same power to communicate heat."

"We are of opinion (say the authors) that it is to the want of attending to this last property, that we are to attribute the great difference which is found in the result of different experiments on this subject. In fact, a simple variation in the volume of the gases, may, in many cases, totally change the result; thus M. M. Clement and Desormes, who endeavoured to determine the specific heat of the gases, by the sudden cooling of large masses, found a very considerable difference for the expression of the capacity of caloric in each gas. In the same manner M. Gay Lussac, in employing considerable volumes, did not find that equality of specific heat, which he had obtained with smaller volumes, and what proves that this remark is well founded, is that the results have always varied in the precise manner in which a difference of conductibility ought necessarily to cause them to vary.

Theoretically considered, it was not improbable that the gases, which have all an equal dilatation, and in which this dilatation remains uniform at all temperatures, should have the same capacity for caloric; and that the law which governs this element of heat should be with respect to them, similar to the law of dilatation, in consequence of their condition of aeriform fluidity. The memoir of De La Rive and Marcet is published in the Ann. de Chim. et de Phys. for May 1827.

4. *The Dead Sea.*—An analysis of the water of the Dead Sea, by C. C. Gmelin, has furnished the following result:—

The density of this water at the temperature of $16\frac{1}{4}$ (Centigrade) is 1.21223.

It is composed of

Chloride of Calcium - - -	3.2141
Chloride of Magnesium - -	11.7734
Bromide of Magnesium - - -	0.4393
Chloride of Sodium - -	7.0777
Chloride of Potassium - - -	1.6738
Chloride of Aluminum - -	0.0896
Chloride of Manganese - - -	0.2117
Sal Ammoniac - -	0.0075
Sulphate of Lime - - -	0.0527
	24.5398
Water - - - -	75.4602
	100.

Extracted from the *Naturwissenschafftiche Abhandlungen.* Ann. de Chim. et de Phys. March 1827.

5. *Note on a phenomenon exhibited by Blowing Machines; by* M. M. Hackette *and* Baillet.—M. Hackette has announced to the society of encouragement that, Thenard and Clement have observed in a blowing machine connected with the works of Fourchembault, department of Nievre, a phenomenon which appears at first sight, contrary to the general laws of motion. They were shewn that a pine board placed near the opening of the tube of the bellows, was pressed forcibly against the sleeve into which the tube was adjusted.

M. Hackette produced the same effect with a common double bellows, whose tube or muzzle terminated in the centre of a disk of copper, of about three inches in diameter; the orifice of the tube, flush with the disk, is one fourth of an inch in diameter. A disk of paper or thin card being placed under the disk of copper, while the air of the bellows was issuing from the circular border of the two opposite disks of equal diameters, the inferior disk remained suspended, and fell immediately when the bellows were stopped. Hachette has obtained similar results in causing water to flow between disks of various forms in a fall of about sixteen feet.

An experiment was made by M. Baillet, some time since, which confirms that of M. Clement, on the valves of steam engines and blowing machines. It shows, that when an elastic fluid moves in a tube of a widened form, or in a conical adjutage, the pressure of the fluid on the interior sides of the adjutage may be less than the atmospheric pressure ; he adds, that this fact being admitted, we ought to infer from it that when the sides are flexible, they may be crushed by the weight of the atmosphere : this is in fact what has occurred in M. Baillet's experiment. This experiment consists in giving to a sheet of paper the form of a funnel, or a horn, open at each end, and in adapting to the little end the nozle of a common bellows ; as soon as the bellows are worked, the paper cone becomes flattened and the expelled air escapes into the atmosphere by an opening less than the primitive opening of the cone.—*Bull. d'Encour, Avril*, 1827.

6. *Rare Insects.*—There exists in Livonia, a very rare insect, which is not met with in more northern countries, and whose existence was for a long time considered doubtful. It is the *Furia Infernalis*, described by Linneus in the *noveaux memoires del'Academie d'Upsal*, in Sweden.

This insect is so small that it is very difficult to distinguish it by the naked eye. In warm weather it descends from the atmosphere upon the inhabitants, and its sting produces a swelling, which unless a proper remedy is applied, proves mortal.

During the hay harvest, other insects named *meggar*, occasion great injury both to men and beasts. They are of the size of a grain of sand. At sunset they appear in great numbers, descend in a perpendicular line, pierce the strongest linen, and cause an itching and pustules, which if scratched, become dangerous. Cattle, which breathe these insects, are attacked with swellings in the throat, which destroy them unless promptly relieved. They are cured by a fumigation from flax, which occasions a violent cough.

Rev. Ency. Juillet, 1827.

7. *Switzerland. Education.*—The city of Zurich is marching in the same career as the capital of Argovie. Its citizens have formed an association to which some bring the tribute of mere scientific knowledge, and others the needful pecuniary aid for the support of a *Technological College*, where at the age of 16 years, are received the pupils of other schools, who abandon their classical studies to devote themselves more especially to commerce and the arts of life. It is only since the commencment of the present year, that this Institution has been open, and it already includes some of the most skillful professors of the canton.

The Instruction is divided into two classes; the first comprehends commercial arithmetic and logarithms, applied geometry, practical mechanics, an abridged history of the three kingdoms of nature; geography, physical and mathematical; natural philosophy; technology; statistics, commercial and manufacturing, of different nations; the German and French languages; calligraphy; Drawing; and manual exercises in different trades.

The second class are taught algebra, trigonometry, theoretical mechanics, zoology, mineralogy, botany, applied chemistry, descriptive geometry, civil architecture, commercial law, the art of modelling, and German, French, Italian and English literature. Thus, the impulse given in England and France, by a few philanthropists, is communicated by degrees, to various parts of the continent; Lausanne, Berne, Geneva and Bâsle, have already technological Institutes for youth, or Scientific courses, brought to the level of the comprehension of ordinary adult workmen. These beneficent creations, besides yielding the happiest fruits to the soil where they are already transplanted, cannot fail to extend the influence of good examples to the neighboring cantons, which include a numerous manufacturing population, worthy of enjoying the zeal of the philanthropists.—*Idem.*

8. *French Institute*, July 9, 1827.—Cuvier T. Cordier made a report on a memoir of Constant Prevost, entitled: Geological examination of this question; *Have the continents which we inhabit, been, at various times submerged by the sea?* The author arrives at this first conclusion; "The countries which are occupied by alluvium (terrain de transport) and sediments, have been covered by the waters during all the times that these deposits required. Supposing that in

general, the level of the sea has actually undergone a slow and progressive abasement, since the origin of things, the author undertakes to explain the manner in which the tertiary deposits of the environs of Paris have been formed, and those connected with them, both in the direction of the Loire, and beyond the channel, to the neighborhood of the Isle of Wight. The substance of his mode of explanation is this: *First epoch.* A sea, calm and deep, deposits the two varieties of chalk, which constitute the borders of the bottom of the great tertiary basin we are speaking of. *Second epoch.* In consequence of the progressive sinking of the ocean, the great basin becomes a gulf, in which the flow of rivers forms chalk, breccia and plastic clay, which are soon covered by the marine spoils of the first calcaire grossier. *Third epoch.* The deposits are interrupted by a commotion which breaks and visibly displaces the beds. The basin becomes a salt lake, traversed by voluminous currents, issuing alternately from the sea and from the continents, and which present the mixture and intermingling of substances which characterise the second calcaire grossier, the calcaire siliceux, and the gypsum. *Fourth epoch.* An irruption of a great quantity of fresh water, charged with clay and marl, in the midst of which there continued to form some deposits of bivalve marine shells. The basin is no more than an immense pond of brackish water. *Fifth epoch.* The basin ceases to communicate with the ocean, and the level of its waters sinks below that of the sea. The muddy depositions of the continental waters continue. *Sixth epoch.* An accidental irruption of the ocean, which deposits sand and superior marine grit; immediately after, the basin almost filled, contains only fresh water, of little depth; it receives a less influx from the land vegetables, and lake animals begin to prevail, and mill stone and fresh water calcaire are deposited. *Seventh epoch.* The succession of these various operations is terminated by the diluvian cataclysm."

The academy directed that the work of Constant Prevost should be printed in the *Recueil des savans etrangers.—Idem.*

9. *Nature of Brome. Electric Conductibility.*—A letter from Auguste De La Rive, professor of chemistry, of Geneva, to M. Arago, dated Geneva, June 4, 1827, contains the following interesting particulars.

"1. I filled a small glass capsule with pure brome, (taken from a portion which had been received from M. Balard, the discoverer,) into which I plunged the two platina wires of the pile, (a pile of sixty pairs, very strongly charged,) very near each other, without obtaining the least deviation in the needle of the galvanometer.

2. In lieu of the capsule of brome, I substituted a perfectly similar capsule of distilled water, and in the same circumstances, I obtained a deviation scarcely sensible. Other trials induced me to believe that water, perfectly distilled, and contained in a vessel composed of a substance absolutely *inattackable* will not conduct electricity at all. The purer the water, and less attackable the vessel, the more feeble is the conductibility, until the deviation becomes insensible.

3. Into the capsule containing distilled water, I poured a few drops of brome; a small portion only of which was dissolved, coloring the water yellow: placed in the voltaic circuit, this solution produced a deviation of 70°, and a disengagement of gas, very abundant, was manifest on the two platina wires. This gas, collected and examined with care, proved to be oxygen at the positive pole, and hydrogen, in precisely double the quantity, at the negative pole, showing that the water alone was decomposed."

It appears from this, that a non-conductor, or at least, a very imperfect conductor, such as *pure water*, may, by mixture with a few drops of a substance, also a non-conductor, *brome*, become a good conductor.

I have found that iodine is in the same predicament with chlorine and brome; when pure, it is a non-conductor; in solution, it conducts well and gives rise to the decomposition of the water. My father, a long time since discovered, that sulphuric acid, when diluted, is a better conductor than when concentrated. Could it be obtained perfectly anhydrous, it might, perhaps, prove to be a non-conductor of electricity. Is it not possible, that in the phenomena I have described, the interposition of heterogeneous molecules, between the molecules of water, may bear some resemblance to that of interposed plates in the passage of electricity in a liquid."

With a view to determine whether brome contains iodine, as has been supposed, professor De la Rive further states, that to a solution of starch colored blue by iodine, he added a few drops of brome, and obtained a compound which gave to starch two distinct colors, the one brownish and the other yellowish. When this compound was submitted to the action of the pile, the yellowish solution assumed a fine blue color at the negative pole, indicating the presence of iodine; and an orange color at the positive pole, to which the brome appeared to be transported. The smallest quantity of brome or of iodine, found in a state of combination may, it appears, be thus manifested. If then brome is a compound which contains iodine, by putting a solution of brome and starch in the voltaic circuit, the iodine will be seen giving a blue color at one of the poles. But though the experiment has been carefully made, no such change has been apparent, and hence, there is good reason to infer, that brome is an element, of the same genus as chlorine and iodine.

Brome, when combined with iodine, goes to the positive pole, and consequently is more negative, which agrees with the observations of Balard, who found that brome had more affinity for bases than iodine. But when water, which holds brome in solution, is decomposed, hydrogen is obtained at the negative pole, as when a solution of iodine is decomposed. If the water be impregnated with chlorine, no gas is obtained at that pole, because chlorine having a greater affinity for the bases than iodine or brome, combines immediately with the hydrogen and forms hydrochloric acid which remains dissolved.

"These few experiments appear to me sufficient to confirm the opinion of M. Balard relative to the nature of brome, and the place it should occupy between chlorine and iodine." —*Ann. de Chim. et de Phys. June* 1827.

10. *Adulteration of Sulphate of Quinine by Sugar, by* M. Winkler.—The author having received some sulphate of quinine mixed with sugar, invites the attention of physicians and pharmacopolists to this new species of fraud, and proposes the following method of detecting it. Dissolve the salt in water, and precipitate the quinine by carbonate of potash.

Filter the liquid and evaporate to dryness; the residue being treated with alcohol, the latter dissolves the sugar and leaves the sulphate of potash and the excess of carbonate untouched: on evaporating the alcohol the sugar is obtained quite pure.—*Bull. Univ. Fer.* 1827.

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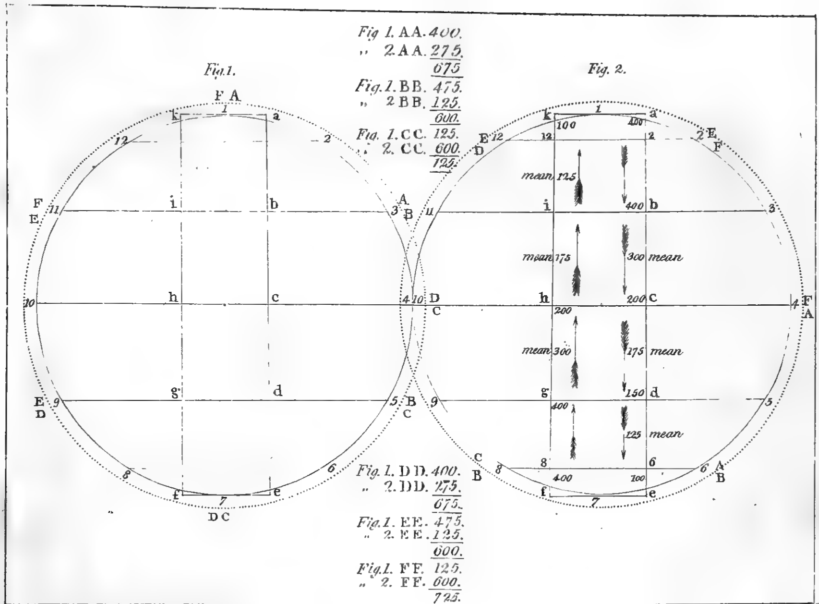

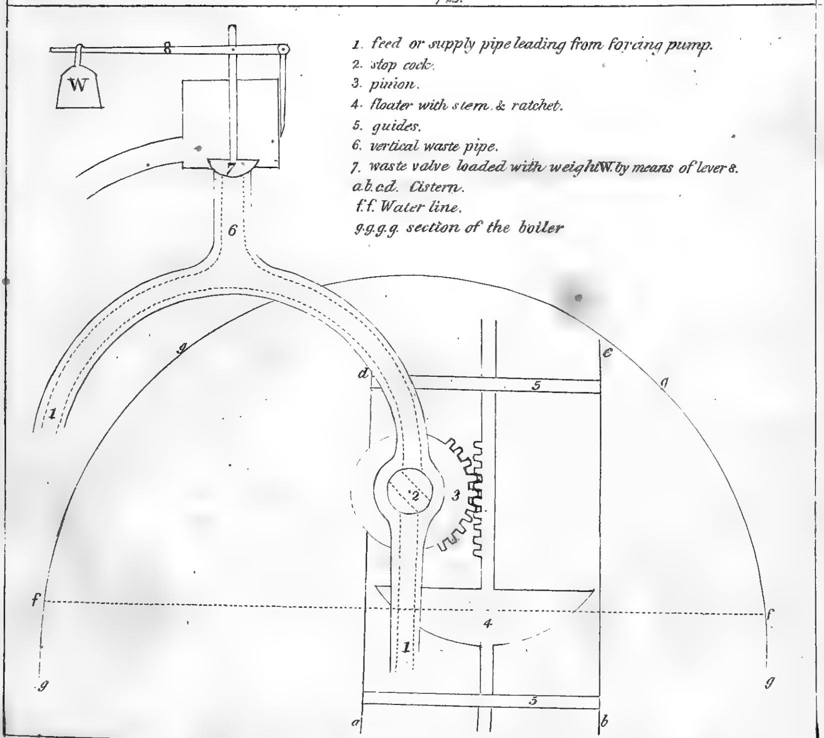

Not made to a scale but to give a general idea of the mechanism.

I.D.

A.Doolittle Sc