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No. 1, Vol. XX, p. 153, line 9 from top, for *stones* read *stars*.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*On the means of safety in Steam Boats; by* John L. Sullivan, Civil Engineer.

New York, January 21*st*, 1831.

Prof. Silliman.—*Dear Sir*,—As it appears from your reply, that my proposed article on the subject of safety in steam boats, was not early enough for the January number of the American Journal, and as you have offered it a place in the April number, I now transmit the communication, and although late for the occasion, there seems to be some reason for preferring that the same work wherein my letter on the proximate causes of danger was republished,* might be the medium of making known the preventive since discovered.

I have long thought that the only *complete* safety to passengers was to be found in a *separate bottom;* and although this be literally true, still, the necessity there is of using the single boat in many situations, and the convenience of that compact form of boiler which has *the furnace and flue within it*, would have been sufficient motive to any conversant with this business to seek out a precaution against the danger attending it; yet when to this is superadded the appalling fact you have stated, that not less than *fifteen hundred persons* have already lost their lives by steam boat explosions in our country, while many more, probably, have been great sufferers who survived their injuries—motive indeed is offered for every one in the profession which comprehends this subject, to devise some mode of safeguard against so great an evil; one that otherwise must in liability be commensurate with the use of steam in navigation.

And I am the more encouraged to address you on this occasion, as I perceive that Mr. Renwick, in his excellent treatise on the steam engine, lately given to the public, confirms my opinion expressed in that letter, on the principal cause of the danger; and I ask leave to quote a few paragraphs from his pages.

* See Mr. Sullivan's letter, Vol. xix, p. 146.

"In all cases where fatal accidents have occurred, the explosion appears to have been due to other causes than the mere expansive force of the steam that would be formed when the boiler is in proper order and supplied with water.

"If we suppose that the supply of water is impeded or checked altogether, the level of that in the boiler must descend, and parts exposed to the action of the fire may become dry; such parts may then become heated far beyond the temperature of the water beneath.

"If by any cause the water from beneath is brought into contact with the vapor and heated surface of the boiler, it will be *instantly* converted into steam of great expansive force, and in quantities for which the usual safety valves are not sufficient to provide an escape; *an explosion must therefore ensue.*—p. 96.

"The water may be brought into contact with these heated parts of the boiler, or with the hot vapor, by the very means that would, in other cases, be applied to diminish the danger. Thus, if the safety valves should be opened, the water which was before boiling quietly, will suddenly rise into violent ebullition; or if the feeding apparatus begin again to act, the level of the water will be raised. In both cases, a contact will take place with the red hot surfaces, and with the intensely heated steam. This is in truth, almost the sole cause of the explosions of boilers, whether of low or high pressure."—p. 97.

"Boilers, when the fire is made within, or when the return flues pass through them, are obviously far more subject to accidents arising from this cause, than those heated from without. Low pressure engines are as liable to them as high, and it is confidently believed, that very many explosions are to be attributed to this cause against which the usual safety apparatus furnishes no protection."—p. 98.

This conclusive explanation appears to be sustained by the experiments of Prof. Johnson of the Franklin Institute, given in your last number, on the rapid production of steam by the immersion of red hot iron; and the rate of production might be estimated on the principle of latent caloric, according to Dr. Black, transferred from the mass of sensible heat.

As the readiest description of my expedient or means of *alarm or notice to be given by the subsiding water itself,* I annex the specification of the invention—intending to claim a patent for it at maturity. It is well known that a privilege of this kind is not often a remuneration for the time bestowed on the subject of it. Yet the usefulness of a new thing depends very much on its being carried properly into effect. To suggest and then leave an improvement to itself, would perhaps in most cases, be productive of little benefit to the public. To induce this care to give perfection to inventions, was a part of the good policy of those who framed the constitution; and though not a few have been futile, still, immense benefits have already resulted from the encouragement held out in the exclusive privilege or property in very useful inventions. The arts were, at the period alluded to, like the nation itself, in their infancy. The nature and *cheapness* of the privilege might well have been expected to produce some crude conceptions; and some old things new vamped; but as education advanced, the principles of mechanics were better inculcated; and the happiest efforts have been those which supply some great deficiency or want arising from new exigencies in the progress of affairs.

Thus, for example, your venerable Yale sent forth the cultivated genius of Whitney, opportunely to aid the agricultural enterprise of all the south. At the moment the great staple indigo was rivalled by that of the Indies, cotton was introduced; but in vain, till his ingenuity, produced the *gin*, and he became the benefactor of half the Union.

But it was not till 1819 that the protection of patentees became effectual. In that year Mr. Webster and Judge Hopkinson rendered the interests of literature and the arts a valuable service, in obtaining the passage of a law giving the circuit court chancery powers and *original jurisdiction* in all cases of this nature; thus by injunction against trespassers, placing the burden of proof on them, no longer therefore supported in aggression by its profits.

Thus effectually placed under the protection of the power that granted the privilege, there is no discouragement to the talents even of the best informed, the most likely to know what has already been done and what is yet wanted in the art, such may propose to improve. The most scientific American would be proud, I should think, to render his country a service as valuable as Watt rendered to his; or like Sir Humphry Davy, would rejoice to shed light—especially the light of safety, on the path of humble industry, or peaceful travel, and free it from the most appalling of the dangers that walk in darkness and waste at noon day. If a more effectual safeguard than that I describe should be by some more skilful mechanician produced, I shall rejoice in it. Until then it is submitted to the public with no other recommendation than its simplicity and intention.

Experience has taught us the *serious lesson,* that there are times when the usual means of safe-guard in steam boats would be unavailing. Practice has also established extensively the use of that form of boiler which has *flues* within; and it may not be reasonable to expect them to be changed, as this would involve much expense. I think this invention will, as to the most formidable cause, make them safe.

Whenever the occasion of alarm or approach of danger occurs, it will be important to supply water liberally without delay to the boiler, whether the engine be in motion or stopped. Then the supply-chamber described in Mr. Renwick's treatise and represented plate II, fig. 2, (which originated with me some years ago) is well adapted to this purpose.

I am well convinced there can be no defence but prevention. The effects of the explosion at McQueen's foundery in this city last summer, serves to show that no *bulwark* that could be erected on the side of a steam boat, would avail as a protection, but might, by shattering the side, endanger her sinking.

When we shall have superadded safety to speed in our steam packets, this branch of navigation will be advanced nearly to its practical perfection.

With the highest respect, I am your friend and humble servant,

J. L. SULLIVAN.

COPY.

Specification of a new and useful improvement or invention to guard against the danger of explosions, denominated the *Alarm Bell Float* and *Phonic Guage of Steam Boilers;* invented by John L. Sullivan, Civil Engineer; described as follows, viz.

The first object of this invention is to cause the *water itself* to give the alarm, when becoming dangerously low.

The second object in importance is to use bells or metallic triangles, or other sonorous bodies, within the boiler to ascertain where the surface of the water is within certain limits.

The principle of their operation is founded in the facts which experiment has established, that bells or sonorous bodies emit a louder sound in compressed air, than in the atmosphere—that the surface of water is favorable to conducting sound, and that it will pass through metallic bodies—that steam is *elastic* and *dense*, and therefore a good conductor of sound: therefore, a bell fixed in a boiler above the water will ring. But I have ascertained, and it is obvious, that if its *rim* touch the water it will not vibrate or sound; so that when *two bells* are placed therein, the one, (for example,) an inch higher than the other, with suitable *wires* leading out from each tongue through packing to the front of the boiler; if the lower one touch the water it will not ring, while the upper one being above the water will sound and be heard; thus making it known to the engineer that the surface is between them. In like manner any requisite number of bells, or sonorous bodies, of the proper size, may be placed the one, half an inch or an inch higher than one and lower than another, so that the actual place of the surface through the vertical space occupied by the whole may be known within half an inch or less, whatever the temperature of the steam. And I give the bells a shape preferably, with perpendicular sides, and without flare, in order to prevent sediment from lodging thereon, which might, if in extreme, lessen the sound; and if the water used be very foul, I place a cover somewhat above and partly around them each, for the same purpose.

The *alarm bell* (or other sonorous body) is of the largest size, preferably, which the upper part of the space, above the ordinary reach of the water, will admit. It is intended to ring *spontaneously* whenever the water shall happen to subside so much as to make bare and expose the *furnace or flue* to the action of the fire within: or, if a single cylindrical boiler, exposing some part of the sides to the action of the fire without, or under, whereby the flue or sides unprotected by the water might become *red hot*, and impart great heat suddenly to any accession of water, causing, (as writers on the subject say,) so great an increase of steam of high temperature and great expansive force, that the safety valves cannot vent it. Nor, for the same reason, could an opening made by a *fusible plug* relieve the boiler instantaneously of so great a volume. And this is manifest from the law of increment of expansive force, compared with increase of heat, as exhibited in the following extract from the table of results of Prony, Dulong, Gerard and Arago, on the expansive force of steam.*

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* Ann. de Ch. et de Ph. Vol. XLIII, p. 74.

	Cent.	Fahr.	Difference for 1 atm.		
1 atm. temp.	100°	=212°			
2 " "	121.4	=250.52	38.52	—diff. between 1 & 2,	38.52
3 " "	135.1	=275.20	24.68		
4 " "	145.4	=293.72	18.52	—diff. between 2 & 4,	43.20
5 " "	153.8	=308.84	15.12		
6 " "	160.2	=320.36	11.52		
7 " "	166.5	=331.70	11.34		
8 " "	172.1	=341.78	10.08	—diff. between 4 & 8,	48.06

According to Mr. Renwick,
4 atmospheres, . . 291°
8 " . . . . . 331 . . . . . difference, . . . 40.
and so usually stated.

Besides, the necessity or expediency of anticipating the danger is made more striking by the law of resistance to the passage and escape of steam through openings, as its velocity does not increase in the ratio of its elasticity. The Treatise of Prof. Renwick, (p. 87,) assigns it the following ratio, viz.

At $1\frac{1}{4}$ atmospheres,	873	feet per second.
2 "	1405	" "
4 "	1663	" "
6 "	1785	" "
8 "	1852	" "

Wherefore, I conceive the best means of safety is, in this as in other instances of liability of exposure to an *uncontrollable* explosive force, to *anticipate the cause* and *prevent* its sudden accumulation or occurrence.

To this end, as the undue decline of the water is the proximate cause, I make that decline of it operate as a *power* to give the alarm, or notice of the near approach of danger.

The method of safe-guard to be described cannot indeed prevent the *primitive* cause, whether it be neglect, defect or leakage; but, it will audibly announce when either of these causes has diminished the water to the limits of safety, and the borders of danger. It will make it known not only to the engineer, but to others, seasonably, to provide against the tremendous consequences of disregarding the warning.

With this view I make a float of heavy plank, the specific gravity of which is about .900; or, preferably, of metallic plate or lead, made just buoyant by attaching cork securely to it, so that when raised out of the water in some degree, it will operate as a *weight*, or power upon the short end of a lever, with which it is connected by a rod from its centre. I suppose this end to be conveniently four inches long, and the other twelve inches; of course the depression of the short end one inch, will raise the long end three inches; I then firmly fix a *bell*, triangle of steel, or other sonorous body, as large perhaps as the space ordinarily vacant above water, or occupied by steam will admit, and fix its tongue or hammer externally, near to it, projecting downwards from an axle, from which an arm extends horizontally towards the float, perhaps one third the length of the tongue, the under side smooth and flat. I then make the said lever, (which extends from the *float-rod*,) to underlap this arm one, two, or three inches, according to size; but at about one half its length from its fulcrum or support, I bend it downward, and at a point that clears the arm of the tongue make an elbow joint, from which a short piece rises at about an angle of 45°, to contact with the said arm, at about two inches from its end; and in the end of this short part of it, I place a small roller to prevent friction while moving on each other; and I put in the angle of the joint a small spring. When therefore the float pulls down the short arm of the lever one inch, the long arm rising three inches, or in due proportion, raises the arm of the tongue three inches, while it at the same time recedes from the bell six or nine inches, as the proportions may be; and as the ends of the lever and arm describe opposite curves, they separate at their intersection, and the arm being liberated the tongue falls (and with the more velocity if the reaction be increased by a spring above the arm) and the bell is struck, and the alarm sounded precisely at that moment when the surface of the water will have settled to a level beyond which it would become dangerous to allow it to fall.

The danger being perceived and the boiler consequently better supplied, the float rises and the lever returns to its position under the arm of the tongue by means of the joint, which closes a little by the pressure of the end of the arm till past it, when the spring throws it out to its proper position for raising the tongue again.

The lever does not, of course, remain in contact with the arm; but when the water rises still more than one inch, it recedes downwards from it. If on the contrary, the water falls and raises the tongue short of the point that would produce the blow, yet returns in consequence of the seasonable restoration of the water, the roller in the end of the lever is to permit this motion easily as the tongue rises and lowers.

Thus independently of constant human agency and care, the water in the boiler will itself, by its motion, give notice of its own undue and dangerous diminution; which is of the more importance as steam boats have to run by night as well as by day, and the practice of placing the boilers on the guard platforms, makes it less likely that a *secret leak* would be seasonably discovered in any other way.

Another modification of the principle is, to place the bell outside the boiler, and communicate the *power of the float* to it by the following means. The tongue instead of striking immediately on the bell, strikes on the end of a rod, communicating (through a packing box) to the outside, and in contact with the short arm of a lever, at the end of the long arm of which is the hammer; and this arm may be elastic as a spring: the impulse thus given within the boiler, from the float to the rod, gives the blow on the bell outside.

In this arrangement the blow has to overcome the resistance of the packing around the rod, (which is not however much,) and the rod has to be returned after the blow, to its place, by hand or by mechanical means; but this mode permits of a louder alarm; the former mode of a warning somewhat more sure. If the bell is external it may be so enclosed as to be accessible alone to the captain of the boat; if within it is not under the immediate care of either the captain or the engineer, but is then independent of human agency, and becomes specially and spontaneously *the passengers' mechanic sentinel.*

For *flue boilers* the float requires the following modification: The depth of water over the flue or furnace may not be sufficient for the float. It may, or must in this case, be divided into two parts, connected across, and of a suitable shape to lay in the deeper water at the sides without touching: its connection with the lever will then be from the connecting piece.

The same principle is also applicable to *locomotive engines*, which have hitherto been made with internal flues, and must always probably be so; and though the same melancholy consequences in degree, are not to be expected in case of explosion, still, some one or two persons may be exposed to injury. This precaution will not only make them also more safe, but more sure of avoiding the damage of rupture and the inconvenience of *delay.*

With sure means of knowing the actual state of the water, steam of much higher expansive force may be employed, and more business done by nearly the same investment of capital.

Among the advantages of this improvement in steam boilers may be also stated, that the circumstance of there being concealed the sure means of loud alarm, will make the engineer more vigilant and careful, because the occurrence of the occasion for it would show *gross negligence*, unless it were caused by a *secret* leak and the consequent incompetency of the *supply pump*, or some other mechanical defect, in which case, he would be exonerated and the cause fortunately discovered in season.

2d. It is applicable to all existing *flue boilers*, and by making steam boats safe, adds to their value and security as an investment.

3d. By obviating the greatest objection to investment in steam vessels, it makes this kind of navigation as a business, more calculable, and lessens the premium of insurance thereon.

4th. It affords to passengers a consciousness of safety and thus increases the use of steam boats.

5th. It brings all the causes of danger more definitely within the reach of Legislative remedy, or of definite provisions of law regarding the proof of boilers originally and periodically, as to size, form, and number of safety valves, &c.

6th. And more especially it will be the means of *absolutely preventing* those calamitous explosions that have been often destructive of life; for it may be fairly presumed that with this apparatus, few if any of those accidents would have occurred, which, according to authentic information, have destroyed at least, fifteen hundred persons in the United States, and caused great suffering to many who survived the first injuries.

And pursuant to the provisions of the law of Congress relative to letters patent, I explicitly claim and declare the principle of my aforesaid invention to be the use or employment of combined bells, or other sonorous body or bodies, so placed within the steam boiler in relative elevation as to indicate by their sound when rung by wires, leading out to hand, the actual place of the surface of the water within the limits of the vertical space between their rims by the ringing of the one next above the surface, and the refusal of the one in contact with it to emit sound.

Also, as above described, an alarm bell, or other sonorous body, within or near the boiler to receive a blow and be sounded by means of mechanical apparatus connecting it and this effect with a float on the water within the boiler, the weight of which operates as a power, as the water unduly subsiding causes the aforesaid, or other equivalent apparatus to work; and by the blow of the tongue or hammer, give notice or alarm as aforesaid, at the near occurrence of that bareness and heat of the flue or furnace, or sides of the boiler, whence danger of explosion arises. J. L. Sullivan.

New York, eighteenth of January, A. D. eighteen hundred and thirty one.

Art. II.—*Specification of an improvement in steam engine boilers, for the employment of carburetted hydrogen gas, as fuel, denominated auxiliary fire; invented by* John L. Sullivan, Civil Engineer, described as follows, viz.

The object of this improvement is to have at command a voluminous flame, capable of instant production or instant cessation, and of regulation as to quantity.

For this purpose, I make a receiver for inflammable liquids, that are to be vaporized; the heat requisite thereto, being only about 100° Fahrenheit, may be derived from the boiler itself.

The vapor or gas thus raised, is conducted by a pipe to a fire within or under the boiler, where it will be instantly and incessantly ignited.

Thus, with a small basis of anthracite, the engine may have the advantage of a lively blaze, filling the space of the furnace, and sometimes extending far into the flue; which will of course be under the water within.

The materials of the gas may be conveniently derived from the oil of turpentine, alcohol, and other inflammable liquids, such as the different varieties of the volatile, carbonaceous and hydrogenous oils and spirits.

As early as the year 1808, while engaged in steam engine experiments, I invented an instrument, whereby tar and steam were commingled and projected into the fire; but that method was found to be too expensive of that material in substance. The present improvement is essentially different: it contemplates the most economical mode of using the most active fuel in generating steam.

It therefore differs from Brown's hydrogen gas engine, which uses a vacuum in cylinders, caused by burning hydrogen gas therein: and from Morey's, which (patented in 1826) forms a vacuum in cylinders by explosive vapors, mixed with common air in certain proportions. My purpose, on the contrary, as before mentioned, is to improve the steam engine in respect to its economy of fuel.

It is a fact, established in chemistry, that the carbonaceous hydrogenous fluids, above named, and alluded to, are freely vaporized at a moderate temperature, and that their elements spontaneously combine in those proportions which form *carburetted hydrogen gas*, and are inflammable on coming in contact with flame or fuel at a red heat, such as anthracite coal well ignited.

I make the said receiver, or generator of the vapor, of a suitable form and size to receive the combustible fluids; and with surface enough for the air to pass over to take up and receive its charge, when it is led by a pipe to the furnace; and when circumstances permit hot and dry air to be admitted, it will take up the vapor more freely.

The introductory pipe or pipes, must each have a cock, not far from the furnace, to govern the supply; and between the cock and the furnace, a wire-gauze screen, on the principle of the safety lamp of Sir Humphry Davy: and to keep the same free from obstruction, I sometimes cause a small stream of steam, led from the boiler, to enter behind the screen of wire gauze, and strike it in the direction of the course of the current of vapor continually or occasionally, and with the more sure advantage when the temperature is high, and the pipe prolonged in the furnace very hot; when some additional portions of hydrogen may be obtained from its decomposition.

The boiler of the engine, when this auxiliary fuel is to be used, should be made with proper adaptation to this intention. Whatever the size or form of the boiler, the bottom of the furnace will be occupied with a narrow grate of coal. When the boiler is made of four long cylinders, in the manner of my anthracite coal furnace-boiler, then this improvement thereon can be conveniently applied; the introducing tubes being so arranged as to direct the vapor upon or into the most lively part of the fire. When the boiler is for locomotive engines, the furnace will be more conveniently placed in an upright cylindrical boiler, with a reverberatory roof or dome within, that will be covered with water; the flue leading into a long horizontal part, or into other upright divisions of the cylindrical boiler, till the heat is principally imparted to the water.

But as the flame thus produced, demands a large supply of oxygen from the atmosphere, and if it were received *wholly through the grate*, it might not only cause the coal to consume disproportionably fast, but the air be deficient in oxygen, I supply it by means of air tubes around the furnace, with convenient stopples or stop cocks, to regulate the quantity, and wholly stop it when anthracite coal alone is used; the air tubes in passing in, contracting to a small orifice to increase the velocity of the air—an exhauster of the funnel or chimney, a fan wheel, as usual, operating to increase the draft.

In cases where the grate is extensive, and it is of consequence to distribute the gas *throughout the fire*, I make use of iron tubes extending from the orifice or orifices of the introducing pipe or pipes, cast with *openings* inclining downward to avoid being clogged. The additional sections of pipe when used, are easily removed and replaced, and serve when at a *red heat* to decompose any water that may, from the said steam pipe, enter with the carburetted hydrogen gas or vapor.

So far as the *flame* extends along the flue, the materials of the fire (which in combustion produce aqueous vapor,) may be decomposed and *recomposed*, renewing the heat with *new accessions* of oxygen so long as flame is present in the flue.

Some estimate of the advantage in point of efficiency from this auxiliary fuel, may be made approximately, from a consideration of the chemical phenomena of combustion.

In combustion, heat is well known to be produced in the ratio of the quantity of oxygen quickly consumed; and the greatest heat known (except that of the galvanic battery,) is from the rapid consumption of oxygen and hydrogen in the proportion to each other which forms water; eight parts of oxygen by weight, to one part of hydrogen; in volume, 1 of oxygen to 2 of hydrogen. But these gases, pure and separate, not being at command for the *practical purposes of fuel*, the nearest approximation thereto, is *this concentrated fuel*,—the use of artificially produced carburetted hydrogen.

The more convenient materials are perhaps those derived from the pine. The *oil of turpentine* in common use being an article of merchandize, and always at command, it may be preferable for my purpose.

Some calculation may be made from the analysis of this liquid by Dr. Ure. At the speeific gravity of 800 it contains 56 carbon, 4 oxygen, and 40 hydrogen. Consequently, one gallon being eight pounds (troy,) contains 61440 grains less $\frac{1}{5}$ for specific gravity, we have 49152 grains; wherefore, according to the above proportions, a gallon will contain of oxygen 1966 grains, of carbon 27520 grains, of hydrogen 19667 grains. Then as 100 cubic inches of light carburetted hydrogen weighs grs. 16,95 (i. e. 12,69 carbon, 4.26 hydrogen,) these constituents of the gas, the carbon being divided by 12,69 gives 2166 times the quantity requisite to 100 cubic inches; using of the hydrogen $2166 \times 4.26 = 9227$ grains, leaving 10.440 grains of hydrogen to combine with the oxygen of the atmosphere.

(less the above 1966 grains,) which, in proportion to the demand for the formation of water, would be 83520 *grains*. Thus, about half the hydrogen would combine with the air, more or less in proportion to the ratio of that producing the greatest heat; the other half in the ratio which the carburetted hydrogen demands oxygen.

Such may be the comparative basis of calculation; and as 2 vols. pure hydrogen require 1 vol. oxygen to form water and 1 vol. carburetted hydrogen, 2 vols. oxygen to be consumed.* The ratio of effect of the latter must be $\frac{1}{4}$ to the former, supposing the combustion to be under equally favorable circumstances.

Whatever would be the effect of 1 lb. of pure hydrogen gas in raising the temperature of water, it would thus seem that the effect of 8 lbs. of the light carburetted hydrogen after proper deductions would be about $\frac{3}{4}$ of 8 lbs. or 6 lbs. besides the effect of the surplus hydrogen combined with atmospheric oxygen. Practical use, experimentally, authorizes the belief, that the carburetted hydrogens as fuel, will be economical in point of first cost. And the incidental advantages of this improvement may be thus stated. The command and discontinuance of a voluminous flame in locomotives, in boats, and in stationary rail-way engines, ferry boats, gun boats, packets, canal and small river steam boats. The fuel to be carried to produce a given effect, is much less in weight than if it were coal or wood. The activity of this fire will better keep up the full tension of the steam, while the engine is rapidly at work.

I therefore declare and claim the principle of the aforesaid improvement in steam boilers and fuel to be, and consist of, the adaptation of boilers as aforesaid, to the reception and use of the carburetted hydrogen gases and vapors, and the combination therewith of a receiver or generator of the said vapor or gases for that purpose.

New York, Jan. 24*th*, 1831. J. L. SULLIVAN.

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* See Prof. Silliman's Elements, Vol. I, p. 402, *(i.)*

Art. III.—*A description of an Economical Steam Boat.*

PROFESSOR SILLIMAN.

Sir—In a branch of navigation so extensive as that employing steam power, *cheapness and durability* are qualities of the *hull* by no means unimportant, either as regards public or private economy, since whatever the amount of the investment, its compensation must be levied on the business done. If vessels can be made to last *twenty* instead of ten years, one tenth of the whole value of any number of them would be saved every year.

There is reason to think that ship building, as an art, has not advanced equally with others. Prejudice may have seconded the interest of carpenters to oppose the introduction of evident improvements in it. This is to be easily accounted for without imputing blame to that respectable class of mechanics. The number of master builders is always small compared with the number in the other trades. They have no motive to economize in construction, as the *merchant owner* is forbidden, by calculation, to try an experiment in principle, that might, from the prejudice or doubt of an inspector from an insurance office, affect unfavorably his insurance. These inspectors who are commonly respectable retired ship-masters, are thus incidentally the depositaries of much power of obstructing, but not of advancing improvement. Thus no essential change in ship building can be introduced but by some ship-builder himself, who ventures from confidence in his new method to build on his own account, in a manner more accordant with principles of mechanical science. Such were the Messrs. Brindleys of Rochester, in Kent, on the Medway.

These gentlemen, one of whom is now resident near New York, may be considered as at the head of their profession; having built forty or fifty ships of war for government.

These *experienced* builders say in a publication which appeared in 1824, in London, in reference to their invented method which is described in the Repertory of Arts, August, 1823, that "among the numerous improvements that have attended the arts and sciences, there is perhaps no one that has made so little progress as ship-building"—that "if any one tolerably acquainted with the first principles of mechanics were to examine the various parts of a ship, as now built in the ordinary way, he would be struck with surprise at the huge masses of timber so disproportionably arranged, and so inadequately connected together."

Should not this and other such testimony silence prejudice, and awaken the attention of a *commercial community.* The Brindleys built the Rochester Indiaman of four hundred tons measurement, capable of carrying nearly *eight hundred tons weight*, and many others in the new way, till the navigation interest in general declined in England, as is well known to have been the fact of late years. Proof was both accidentally and intentionally given of their abundant strength.

The principle is to place all the materials used in the position that gives strength to the fabric. Accordingly every piece adds to its thickness and tightness. The whole ship is bound together with iron bands like a cask. But instead of being a cask of one thickness of staves, it is composed of a number in succession ; and not only successively bound on each other, but bolted successively through and through, and drawn together by numerous screw bolts. Then, as every successive coat or thickness of plank is caulked and pitched, the structure is a solid mass of wood and iron and carbonaceous impervious imperishable substance. The keel is secured on externally, and instead of being a cause of danger from its exposed position, serves as a defence ; because it may be even knocked off or ground to pieces by violence without causing the destruction of the hull. Within, there is a kelson and floor timbers to receive the loading. The liability to spring a leak is diminished in proportion to the number of layers. Loading increases the strength of a ship while she floats.

Insurance and custom not so much influencing construction of steam boats as ships, this method is peculiarly suitable to them ; because they ply principally on our fresh waters and in the heat of summer, when their upper-works are very liable to shrink and admit the weather. Of course the causes of decay, *heat and moisture* operate as powerfully as prematurely. But if the sun can have no effect but on the external coat, all the others will remain sound. The Messrs. Brindleys observe that their mode of building is very economical, not only because it takes less timber, but requires *none that is crooked,* which costs twice or thrice as much. Is not this fact worthy of the attention of a *naval power?* Might not the method be fairly tried by government in one instance on a moderate scale? For it is the premature decay, and necessity of consequent repairs that makes a navy so very expensive even in ordinary.

The *least costly engines* are those which are placed horizontally, and use steam of high temperature and great force. They are much employed on the Mississippi. There is one in a new boat on the Hudson, made at Pittsburg. It is represented in Mr. Renwick's Treatise, page 6.

But the *most economical use of fuel* for steam, is where the engine works it expansively, using a condenser. To this subject a chapter of that work is well devoted : at page 73, a table of effects shows that steam of $1\frac{1}{6}$th atmosphere, filling the cylinder, consumes fuel, say as 1, effect 10, while 4 atmospheres, using $\frac{1}{8}$th cylinder full, consumes half as much fuel, and the effect is 20, or double. To raise the steam from 1 atmosphere to 4, requires an increase of temperature of only 45°, that is, from 212° to 291°. This shows the advantage of using even with a condensing engine, boilers that will safely bear 4 atmospheres.

The *form of boiler*, for this and for other reasons, which I have supposed the most economical, is calculated to use anthracite coal, and do without *inside* flues.

It consists of *four single cylinders*, placed side by side, the two middle ones a little asunder, to allow the coal to fall from hoppers over this space on to a sharp ridge, which causes it to slide down to two long narrow grates under the middle boilers. The draft is thence sidewise under the outer ones, rising over a ridge to impinge on their bottom before it turns down under them to reach the vents on the other side ; which are small funnels leading to the main funnel above.

This method allows the coal to burn near the bottom of the boilers, and advantageously as the *course* of the draft does not intercept the heat.

The *carburetted hydrogen gas fire*, as an auxiliary for flame, is very conveniently applied to this form of boiler ; when if it be found to require more surface to act on, the number of cylinders might be six, instead of four : and *three*, (half this arrangement,) may be conveniently employed in some instances.

Thus I have endeavored to present in one view the most economical hull ; the manner of working an engine with most effect of steam ; the manner of making a boiler to use at once the most compact, cheap and active fuel ; the manner of *preventing explosions ;* the manner of *supply*, by throwing in water when the engine is not in action; the whole perhaps constituting the least costly and the most durable and powerful steam boat.

But it remains to say, that although safety is thus provided for, the covered barge is capable of being the swiftest as well as the most convenient and elegant method of carrying *passengers;* because the proportion of power that may be placed on board the engine boat may be much greater than usual, while the buoyancy of the barge occasions, in a smooth *wake,* little resistance.

Hitherto the requisite timber and iron, in a hull where the engine works perpendicularly and the cabins are so long as to afford large accommodations, has been such that perhaps the *carpenter's bill* of no class of vessels has been so high.

If these suggestions should tend to promote the extension or profit of this branch of navigation, the appropriation of your pages to this subject thus liberally will not be without public benefit.

Respectfully yours, &c.

John L. Sullivan.

New York, Feb. 19, 1831.

Art. IV.—*Remarks on the prevailing Storms of the Atlantic coast, of the North American States;* by William C. Redfield, of the city of New York.

The changes which usually occur in our atmosphere may be considered as of two kinds or classes. In the one class are recognized those effects which are the result of gradual variations in the temperature, humidity, and density of the atmosphere. In the other, we include all those active and more striking changes, which result from the agency of unusual or irregular movements of the atmospheric currents. These extraordinary movements we denominate storms, hurricanes, &c.; and they exhibit, or develope the most striking atmospheric phenomena with which we are acquainted.

The occurrence of storms is sometimes conjecturally ascribed to mere changes in electricity; but the natural tendency to equilibrium, in the more subtle, as well as the denser fluids, appears to forbid this supposition, and these electrical changes seem rather to occur in consequence of other disturbing causes, which operate to destroy the general equilibrium. It has been justly remarked, that to ascribe every phenomenon, with the cause of which we are unacquainted, to electrical agency, serves rather to retard than to advance our knowledge of nature.

Rarefaction, occasioned by an increase of temperature, has also been adduced as the immediate agent in producing storms; but, to say nothing of the difficulty of proving an extraordinary increase of temperature before a storm, it has been justly remarked by Dr. Hare, that "the air, being a perfectly elastic fluid, its density is dependent on pressure as well as on heat, and it does not follow that air, which may be heated in consequence of its proximity to the earth, will give place to colder air from above. The pressure of the atmosphere varying with the elevation, one stratum of air may be as much rarer by the diminution of pressure consequent to its altitude, as denser by the cold consequent to its remoteness from the earth; and another may be as much denser by the increased pressure arising from its proximity to the earth, as rarer by being warmer. Hence, when unequally heated, different strata of the atmosphere do not always disturb each other."

It is, indeed, the prevailing opinion that change of temperature, is a principal cause of those extensive currents or revolutions of the earth's atmosphere which we distinguish as trade winds, monsoons, &c.; and it is to the operation and effect of these great and regular moving masses or currents, that we are disposed mainly to ascribe the more active and striking meteorological phenomena which occur in every latitude. But whether this be admitted or not, it must be evident, that to ascribe the occurrence of storms and hurricanes chiefly to change of temperature or rarefaction, in a *particular locality*, whether in the tropical or temperate latitudes, is falling into as great an error as if we were to ascribe the tides of the bay of Fundy, or the coast of Patagonia, to the specific attraction of the heavenly bodies on those localities. Indeed, the analogy between the tides and currents of the ocean, and of the atmosphere, is perhaps sufficient for our argument, for as the great semi-diurnal swell, or tide wave of the ocean, is brought to bear with concentrated effect upon its smaller portions, or tributaries, so do the massive currents or tides of the atmosphere often press with corresponding energy upon its more detached portions, while seeking to restore the general equilibrium. We have the full effects of heat and rarefaction exhibited on nature's grandest scale, between the tropics, acting jointly with other causes, and the aggregate and uniform result, is only that of a regular and moderate breeze or trade wind, and an equable state of the barometer. To create in the midst of these equable winds or elsewhere, by the aid of rarefaction, a fanciful vacuum into which the atmosphere, from a distance of many miles, and even many hundreds of miles, is to rush with all the fury of a storm, is to do violence to the established principles of natural science. To ascribe such effects to such a cause, is no better warranted than to refer all storms to the direct influence of electricity and magnetism.

As connected with these remarks, the following explanations are given of some of the principal terms used in application to this subject.

WIND *is air in motion;* either progressively over the surface of the earth, or relatively, as regards the surrounding portions of the atmosphere.

A CALM, *is a cessation of motion in the air at the surface of the earth.* It is obvious however that a given portion, or current of the atmosphere may be stationary as regards this surface, and yet may be rapidly moving through, or penetrating other portions of the atmospheric fluid. A calm, therefore, affords no evidence of a state of quietude in the surrounding, or superincumbent portions of the atmosphere.

A STORM, *is a violent wind, passing over the earth's surface.* In popular language, a storm is supposed to mean a wind or tempest, accompanied by rain, or indications of rain. In the views to be submitted, the term will be used in its most general sense, but chiefly as applying to those winds or atmospheric changes, which are attended by a condensation or deposition of vapor.

A HURRICANE, *is a wind or tempest of the most extraordinary violence.* It has been stated as a distinguishing characteristic of hurricanes, that *the wind blows from different points of the compass,* during the same storm.

It is an obvious fact that most of the storms of the Atlantic coast of the United States, excepting thunder gusts, blow from an eastern quarter of the horizon. It has also, been often noticed, and the fact is recorded by Dr. Franklin, that north-east storms commence in the south-west and make progress from thence in a north-east direction, being experienced much sooner at Philadelphia than at Boston. Another leading fact, noticed by every observer, is, that in north-east storms, a return of fair weather *first appears to the leeward* or westward; or, in other words, that these storms first terminate as well as commence in the south-western quarter. Some attempts have been made to explain the manner in which storms blowing from the north-east, should, at the same time, be found extending in that direction, without visible cause, and in apparent opposition to their own forces.

The unsatisfactory character of these explanatory theories has induced the writer to pay some attention to the foregoing facts, and to the other phenomena exhibited by the storms of our climate, which has resulted in an apprehension that the general causes and manner of operation of these storms are not beyond the reach of investigation.

The storms experienced in that portion of country bordering upon the sea coast, and on the adjacent parts of the Atlantic ocean, are commonly viewed as forming two varieties, one of which is distinguished as blowing from the north-eastern, and the other from the south-eastern quarter of the horizon. These do not greatly differ in their ordinary effects, although those from the north-east have usually a more prolonged duration, and exhibit a more sensible reduction of temperature. Some account of the phenomena and ascertained progress of a south-eastern storm, which occurred in September, of the year 1821, may, in its leading features, apply to many other storms, and will, it is believed, afford sufficient ground for the conclusions which we shall attempt to establish.

This storm, as experienced in the central parts of the state of Connecticut, commenced blowing violently from E. S. E. and S. E. about six o'clock on the evening of the 3d day of September, having been preceded by a fresh wind from the southern quarter, and flying clouds. It continued blowing in heavy gusts, and with increasing fury till about 10 o'clock, P. M. when the wind suddenly subsided. A calm or *lull*, of perhaps fifteen minutes duration ensued, which was terminated by a violent gust from the north-west, which continued till about 11, P. M. and then gradually abated. Much damage was sustained, and fruit trees, corn, &c. were uniformly prostrated towards the north-west.

It afterwards appeared that the same storm was experienced, with at least equal violence, at New York, about three hours *earlier* than at the point before mentioned, but blowing from a more eastern quarter, and terminating its ravages at about 8, P. M. having also been preceded by a fresh wind from the southward. That in the north-eastern parts of Massachusetts, it was experienced some hours later than in Connecticut. That at Providence, in the state of Rhode Island, where the memorable gale of 1815 had raged with such terrific fury, the storm was felt from the south-eastern quarter, but not severely; as was also the case in the south-eastern parts of Connecticut. In the north-western portions of the latter state, and the adjacent towns of Massachusetts, the gale blew with its chief violence from the north-western quarter, and the trees and corn, as the writer afterwards witnessed, were uniformly prostrated *towards the south-east*. At Worcester, in Massachusetts, the storm occurred some hours later than in Connecticut.

It appears, therefore, that the more violent effects of this storm were of limited extent from south-east to north-west, but were exhibited over a much greater range of country from south-west, progressively, to north-east; that in the central part of Connecticut, the mass of atmosphere upon the earth's surface, was moving for several hours, apparently towards the north-west, with a probable velocity of seventy five to one hundred miles per hour, while in the northern parts of Litchfield county, in the same state, at a distance of say forty miles, the wind, at about the same period, was blowing with nearly equal violence *towards* the south or south-east. Towards the sea coast of Rhode Island, from whence the gale at Middletown, in Connecticut, seemed to come with such surprising velocity, the gale was of no extraordinary character; while at New York, the storm had ceased blowing from the eastward, soon after its commencement from the south-east in this part of Connecticut.

In reviewing these facts, we are led to inquire how, or in what manner it could happen, that the mass of atmosphere should be found passing over Middletown for some hours, with such exceeding swiftness, towards a point apparently within thirty minutes distance, and yet never reach it; but a portion of the same or a similar mass of air, be found returning from that point with equal velocity? and how were all of the most violent portions of these atmospheric movements which occurred at the same point of time, confined within a circuit whose diameter does not appear to have greatly exceeded one hundred miles? To the writer there appears but one satisfactory explication of these phenomena. *This storm was exhibited in the form of a great whirlwind.*

This position renders it proper to notice a class of winds which we have not previously considered.

Some idea of the existence and character of whirlwinds or tornadoes, as they are sometimes called, is common to most persons who are at all conversant with the subject of meteorology. One variety of whirlwind is often exhibited during the prevalence of dry westerly winds, which, owing to partial obstructions or other causes, frequently form into eddies or whirls, the rotative motion of which increases with their progress as they are wafted along by the surrounding atmospheric current, raising clouds of dust and other light substances, till they finally become broken or dissipated. The writer has seen a whirlwind of this kind, operate with so much violence in passing over a river, as to raise a white cloud of spray to the height of some forty or fifty feet, which disappeared before reaching the opposite shore. Whirlwinds of a still severer character sometimes occur, and are, by seamen, denominated *white squalls*, from the white appearance of the spray thus raised into the atmosphere. Doctor Franklin, it is well known, maintained the identity of these smaller whirlwinds with water spouts.

Another class of whirlwinds, of more formidable character, are those which sometimes attend the thunder storms, or *gusts*, of the Atlantic states, and more frequently, ravage the fields and forests of the regions west of the Alleghany mountains, carrying desolation and death in their progress. Like the smaller class, they are carried along by the attendant wind of whose mass they form an integral portion. Their ravages are generally confined to a narrow track, often of but few yards in breadth. Rising at times, over objects in their path, and leaving them untouched, they again descend to the surface, and continue the work of destruction. The chief force of these winds evidently consists in the almost inconceivable rapidity with which the mass revolves about its own axis of rotation, a velocity which is, therefore, unopposed, except by the obstacles brushed upon at the earth's surface, and which is maintained in full activity by the concentric, or tangentical pressure, or action of the surrounding portions of the atmosphere.

It is believed that no valid reason can be shown, why much larger masses of the atmosphere may not acquire, and develope, rotative movements, similar to those which are exhibited by whirlwinds, and the demonstrated existence of the latter ought to free us from the charge of maintaining a mere hypothesis, when we ascribe the same character to such storms as that which we have already described, if we can show that they are attended with corresponding phenomena.

It is demonstrably evident, that at any point over which the center of a whirlwind may pass, the wind must, at the moment in which this center passes, suddenly change to a direction almost exactly opposite to that in which it has been felt during the preceding part of its progress, and that at the immediate center of the whirl, little or no violence of effect can at any time be experienced. It is further evident that, towards one side of the track of a whirlwind, it must blow in a direction which is *retrograde* from that of its progress, while, on the opposite portion of the track, the direction of the wind will be found in the contrary direction, and coinciding with the progressive motion of the body of the whirlwind. Now these known phenomena, or peculiarities of a whirlwind, appear to have been fully exhibited by the storm in question, though on a more extensive scale, and for aught that appears, may also be exhibited in some degree, by every other storm. We might expect, however, to find in the supposed revolutions of the great masses which compose our easterly storms, the violence of effect to be lessened in due proportion to the magnitude of the revolving mass, and the increase of surface affording resistance, except in cases where the amount and duration of the rotative forces should be adequate to the production of equal velocities. The duration of the storm, also, at each of the several points over which it passes, instead of being momentary, as in the lesser whirlwinds, must increase with the dimensions of the revolving mass.

If our position be conceded, then it is no longer difficult to explain the paradox, or mystery, which otherwise pertains to the phenomena exhibited by this storm, and all others of a similar character. We can now perceive why the wind may blow, even with excessive violence, at one point, and yet scarcely be felt in a position but a few miles distant from the regular track of the storm. We can trace the circumvolution which produces such a contrariety in the direction of the wind on the opposite sides, or portions, of the revolving mass, and we can appreciate the centrifugal tendency and other causes, which produce about the rotative axis of the storm, that suspension of effect which occurs on each successive portion of the track over which its center of rotation may pass. We can also perceive the cause of the sudden change of wind at this crisis of the storm, and we can satisfactorily explain the more gradual changing or veering of the wind, which takes place on the more eastern or western portions of the advancing storm. We can discern the reason why, in seamen's phrase, "a north-wester will never remain long in debt to a south-easter," and we may also appreciate some of the causes which render the last semi-diameter of the rotative mass a dry wind, in a short period after this change in its direction.

Nor do we any longer find difficulties in conceiving of the regular progress of the storm from south-west to north-east, as a component portion of the general mass of atmosphere which has previously been tending in that direction. This progress still continues while the stormy mass is revolving around its own moving axis, and we can readily comprehend the violent effects of its unresisted rotation, while this velocity becomes accelerated by nearly all the oblique forces, and perhaps resistance, of the circumjacent currents or masses of moving atmosphere.

In order to give a further history of the storm of 1821, and lest we should fall into the error of adopting a conclusion, which a more complete array of the facts might fail to warrant, we will give some further notice of the first appearance and entire progress of this storm, so far as we have been able to obtain accounts of it. This will enable us to identify its track, and exhibit further evidence of its character as a whirlwind, or, will afford us evidence with which to combat that conclusion, if it be erroneous.

The earliest supposed trace of this hurricane which has been obtained, is from off Turks-Island, in the West Indies, where it appeared on the first of September, two days previous to its reaching our coast. It was felt there severely, but at what hour in the day we are not informed.

The next account we have is from Lat. 23° 43′, where the storm was severe, Sept. 1st, from south-east to south-west. Whether these two accounts are considered as identifying the storm, or otherwise, will not, at this time, be deemed material.

Our next report is from Lat. 32° 30′, Lon. 77° west from Greenwich, on the night of Sept. 2d, a hurricane for three hours.

At 3, A. M. on the 3d of September, a severe gale was experienced thirty miles outside of the American coast, off Wilmington, North Carolina.

At Wilmington there was no gale.

At Ocracock bar, N. C. at day light on the morning of the 3d, a severe gale from east-south-east.

At Edenton, N. C. the gale was at north-east.

Off Roanoke, on the morning of the 3d, a dreadful gale at east, then south-west and north-west.

A vessel from Charleston, S. C. two days previous to arriving in the Chesapeake, experienced the gale at 4, A. M. on the 3d, from south-east to west-south-west.

A vessel from Bermuda, experienced the gale from the *westward*, on the inner edge of the gulf stream.

Another vessel, from Charleston, *did not experience the gale.*

In Lat. 37° 30′, on the inner edge of the gulf stream, gale from the *westward*, with squalls.

On James' river, Virginia, the gale was severe from north-west.

At Norfolk, Va. the gale raged, on the 3d, for five hours, from north-north-east to north-north-west, and terminated at the latter point; greatest violence from 10, A. M. to 1, P. M.

At sea, forty miles north of Cape Henry, severe from south-east, changing to north-west.

Off Chincoteague, coast of Maryland, on the 3d, gale from south-east.

At Snowhill, Maryland, gale commenced at 11, A. M.

In Lat. 38° 30′, Lon. 74° 30′ gale south by east.

Gale reported as slight in the gulf stream.

A ship from Boston, bound to Norfolk, *experienced nothing of the gale.* On the 3d, was in Lat. 40° 19′, weather foggy, and *light winds from south-east.*

At Morris' river, Delaware, the gale was from east-south-east.

No hurricane was felt at Baltimore.

At Cape Henlopen, Del. the gale or hurricane commenced at half past 11, A. M. from east-south-east, shifted in twenty minutes to east-north-east, and blew very heavy for nearly an hour. A calm of half an hour succeeded, and the wind then shifted to the west-north-west, and blew, if possible, with still greater violence.

At Cape May, (New Jersey) commenced at north-east, at 2, P. M. and veered to south-east, and blew with violence. After abating fifteen minutes, it again blew with increased violence for two hours, and then abated. *The sun set clear, with pleasant weather, at which time not a cloud was to be seen in the western horizon.*

At Bombay-Hook, near the mouth of the Delaware river, the gale blew from north-north-east, to west-north-west.

At sea, forty miles north-east of Cape May, the gale was at south-east, and lasted eight hours.

At Philadelphia, the storm commenced at 1, P. M. on the 3d, from north to east, and raged with great violence *from north-east to north-west*, during the greater part of the afternoon.

At Trenton, (New Jersey) the gale commenced at 3, P. M. with the wind *from north-east.*

In Lat. 39° 20′, Lon. 73° 30′, the gale blew from east-south-east to south-south-east, and continued eight hours.

At New York, the gale was from north-east to east, and commenced blowing with violence at 5, P. M.; continued with great fury for three hours, and then changed to west. More damage was sustained in two hours than was ever before witnessed in the city, the wind increasing during the afternoon, and *at sunset was a hurricane.* At the time of low water, the wharves were overflowed, the water having risen thirteen feet in one hour. Previous to the setting in of the gale, the wind was from *south* to *south-east*, but *changed to the north-east at the commencement of the storm*, and blew with great fury till evening, and then shifted to the westward.

At the quarantine, Staten-Island, the wind was reported as east-south-east. Other accounts fix it at east.

At Bridgeport, Conn. the gale commenced violent at south-east, at 6, P. M. and continued till 9, P. M.; then shifted to north-west, and blew till nearly 11, P. M.

At New London, the gale was felt from 7, P. M. to 12 at night.

On the coast of Rhode Island, between Point Judith and Watch-hill, gale from the south.

At Middletown, Connecticut, violent from south-east for five hours.

At Hartford, commenced heavy from south-east at 7, P. M.

At Springfield, Mass. violent from 9 to 12, P. M.; then changed to the westward.

At Northampton, from south-east on the same evening.

At Worcester, Mass. in the night, between the 3d and 4th of September.

At Boston, the gale commenced at 10, P. M., but does not appear to have been severe. At the time the storm was raging with its greatest fury at New York, the citizens of Boston were witnessing the ascent of a balloon, and the aeronaut met with little or no wind.

The general course of this storm, northward of Cape Hatteras, appears to have been from south-south-west to north-north-east, and of its further progress we are uninformed.

It appears from the foregoing statement of facts, that this storm, previous to its reaching Long Island, extended but a moderate distance inland, and that its influence seaward from the coast was almost equally limited;—that, between these boundaries, it maintained a regular progress along the coast, from a great distance towards the south, and probably even from the neighborhood of the West-India islands;—that this progress, though slower in the lower latitudes, was, after reaching the American coast, at a rate not greatly differing from thirty geographical or nautical miles per hour, which is presumed to have been nearly the velocity of the direct southerly current prevailing in the atmosphere at that time, at a medium height from the surface; and this rate of progression appears to have governed the duration and termination of the storm at each place over which it passed;—that on the western margin, or verge of the storm, or at those places most distant from the sea, the wind was northeasterly or northerly, while on the opposite verge, at sea, the wind was southerly and westerly;—that along the central portion of the track, the storm was violent from the south-eastern quarter, *changing suddenly to an opposite direction;*—and that there was previously and subsequently, no prevalence of an easterly wind, nor was there any other apparent cause for a direct movement of the atmosphere from that quarter; all the existing tendencies being in another direction. The *center* of the storm or hurricane, appears to have been generally outside the coast, till, reaching Long Island, it crossed the same, and entered upon the State of Connecticut. It seems also to have passed westward of New Haven, and to have entered the valley of the Connecticut river near Middletown, and after partially following that valley for some distance, and crossing the State of Massachusetts, the storm must have disappeared towards the eastern coast, and its further progress does not appear to have been reported.

The general analogy or correspondence of the foregoing facts to the known phenomena of whirlwinds and tornadoes, will, it is believed, be sufficiently evident, at least so far as the difference in the magnitude and other circumstances of these rotative masses, will permit of the resemblance. As it will be assumed, in the progress of our remarks, that this peculiarity of motion is a general attribute of storms, it may therefore be proper to sum up these points of resemblance in a more concise manner.

1. The regular progress of both the storm and the whirlwind from the point where they first become appreciable in their effects, till their ultimate extinction, uninfluenced by any particular direction of wind which they may exhibit, deserves especial notice.

2. The limited diameter of the known smaller, and the supposed larger whirlwind, or storm, as compared with the extent over which they sweep in pursuing their several tracks, is an important resemblance, and is evidence of a similarity in the mode of operation.

3. The regular and obvious proportion which the several diameters of the storm and whirlwind, and their rate of progression, bear to their duration, at each point over which they pass.

4. The different and opposite, or nearly opposite directions in which the wind is found to blow upon the opposite sides of the track, and also upon the opposite marginal portions, of both the storm and the whirlwind.

The last consideration, if established, hardly falls short of demonstrative evidence of the supposed identity in the mode of action in these different masses of moving atmosphere. Every person, on examining the track of a destructive whirlwind, where it has passed through a forest, will, in crossing that track, often find the trees prostrated in exactly opposite directions, and it is obvious that this effect must necessarily follow, as the result of the acknowledged cause, a circular, or rotative force in the whirlwind. The same effect was equally apparent, only on a larger line of observation, after the storm or hurricane of 1821, as already described. The same general evidence of a sudden or a progressive change in the direction of the wind, runs through all the accounts which we have given, or which it is in our power to submit, in relation to other storms.

In relation to whirlwinds of the smaller class, we may here take occasion to remark, that it is not conceived to be essential to the character of a whirlwind, that its axis of rotation should occupy a vertical position, or one but slightly inclined to the plane of the horizon. On the contrary, the axis, or center of gyration, in whirlwinds of a limited character, may, and probably often does, occupy a horizontal position at a considerable height in the atmosphere. This variety of whirlwind is presumed to enter largely into the formation of thunder-storms and squalls, and particularly hail-storms.

Having attempted to establish the circumrotative character of the south-east storm which has been described, we are led to inquire whether other south-easterly storms possess the like character; and whether this be also an attribute of the north-eastern storms of our coast, and also what constitutes the specific difference of character in these storms.

If the foregoing views be sufficiently established, it must follow, that *the direction of the wind at a particular place, forms no part of the essential character of a storm, but is only incidental to that particular portion or parallel, of the rout or track of the storm which may chance to become the point of observation.* We have seen that in order to blow from the south-east, the center of the storm, (if its progress be north-eastward) must pass near the point or parallel from which we observe it, *the direction of the wind being, in all cases, compounded of both the rotative and progressive velocities of the storm, in the mean ratio of these velocities;* while towards the northern and western margin of the same storm the wind is north-easterly. Such south-east storms, their central portions being on, or near, the land, must necessarily be circumscribed in their influence by the obstructions and elevations of the interior, and particularly by the mountainous ranges. Being thus confined or limited in their dimensions, they of course extend only to a corresponding distance on the opposite semi-diameter to seaward, and this furnishes the reason why the south-east storms experienced on land, are never known to extend, at sea, to any great distance from the coast. The narrow dimensions of the south-east storm also favor its more rapid impulsion by the prevailing southerly current of atmosphere, and this sufficiently accounts for its comparatively short duration.

It results also from these views, that if a storm blow from the north-east along our coast, its central portion, or axis, will be found to range at a considerable distance from the coast, at sea. If such a storm be also felt over a considerable portion of the country adjacent to the coast, its dimensions must be far more considerable than those of the south-east storm, and if in addition to its increased dimensions, it be found to advance with less rapidity than the smaller storm, its increased duration will be sufficiently explained.

The generally admitted progress of our storms from south-west to north-east is confirmed by all the evidence which the writer has been able to obtain. It has been freely assumed also in these remarks, from what was deemed to be sufficient evidence, that most storms, if not all, exhibit in a greater or less degree a circumrotative character, or in other words, that they usually blow in the form of extensive eddies or whirlwinds, and the specific character of the north-east and south-east storms of our coast, and their points of difference has been explained upon these principles. Should the evidence produced be deemed insufficient to establish these views, further confirmation may be obtained for them by ascertaining the direction of the wind in an easterly storm, on a line drawn across its track from north-west to south-east. The farther inland such an enquiry is extended, the more northerly will have been the direction of the wind, till we get beyond the extreme verge of the storm. On the other hand, as we approach the seaboard the wind will have blown in a more easterly direction, and veering further as we extend our enquiries in that direction. If we farther prosecute the enquiry among the records of our nautical friends we shall find a further veering of the wind to east, and ultimately to south-east and south; till towards the opposite or south-eastern margin of the storm its effects will have been felt from south to south-west, and generally to west or north-west, till the circle is completed.

If the position of a ship on our coast, be within the north-western half or semi-diameter of the storm, it will usually commence from a point to the northward of south-east, veering, ultimately, by way of north, to the westward. But if the position of the ship be within the opposite or south-eastern semi-diameter, the storm will commence between south-east and south, veering afterwards to south-west, west, and even north-west. Rain, or the deposition of vapor in any form, seems chiefly confined to the north-eastern or advancing semi-diameter of the revolving mass, though its external or marginal portions are often free of clouds; while most of the south-western semi-annular section or division, displays the appearance of clear weather. Near the frontier margin of the revolving mass, upon the land side, we may sometimes notice the clouds which form the upper stratum connected with the storm, disposed into corticular ranges or layers, of greater or less density, and with various degrees of frequency and harmony in the arrangement. North-eastern storms often blow but moderately, which is to be ascribed to a sluggish rotation, and comprising, usually, a more extensive surface than south-eastern; they bring to us, in their extensive revolution, the humid and chilly atmosphere of the north-eastern coast.

As the storms of the North American coast, may sometimes be traced, as we have seen, from a great distance in the general direction of that coast, it may not be unavailing to seek for the primary causes which bring them into operation.

Owing to the general prevalence of the trade winds in the tropical regions, and which, in the northern Atlantic, extend to about the thirtieth degree of latitude, the incumbent mass of atmosphere is in constant progress towards the American continent, and into the gulf of Mexico. Continents, and especially elevated and mountainous ranges, are well known barriers to the trade winds, which being thus obstructed by the isthmus of the two Americas, restore the equilibrium of the northern hemisphere by a general and regular efflux of variable winds, tending back to the north-east in the temperate latitudes. This prevalence of these compensating winds is so uniform as to occasion an average difference of seventeen days in favor of the eastern passage of packet ships engaged in the European trade. Even in England they have two hundred and twenty five days of westerly wind to one hundred and forty days of an easterly direction, and if our view of the easterly storms be correct, this tendency is more general and uniform than has hitherto been supposed, most of the other winds being, in that case, but irregular modifications of the westerly or returning trade wind. The prevailing effect upon the North American coast, during most parts of the year is that of a south-westerly wind, but becoming more westerly as we advance northward.

This general current of atmosphere is often qualified in its direction, and acted upon obliquely by the more western and north-western land winds. These several winds or modifications of the same general current, often prevail in stratified currents overlaying each other, the most western of these currents forming generally the upper stratum. It is probable, as already suggested, that these winds are but the recoiling, or returning masses of the trades which penetrate to the bottom of the gulf of Mexico, the superior strata of which may be sent back from the most western points of the horizon from the highest barrier which is found in the great Mexican elevations, or even the Chippewayan range.*

There is a class of these variable returning winds, which appear to recoil in a comparatively short circuit from the gulf of Mexico by way of the North American coast, and from whence, in the autumnal and winter seasons, they often fall in upon the trades, from a northerly direction, at different points between the eastern limit of the gulf of Mexico and the meridian of the Bermudas, thus coinciding in effect with another obstacle to the regular progress of the northern portion of the trades which we shall now mention.

At these seasons the northern margin or parallels of the trade winds in sweeping towards the gulf, must necessarily come in collis-

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* It appears from a record of the prevailing winds at Little Rock, on the river Arkansaw, that during a period of five months ending with October last, the winds from south-east to south-west were in the proportion of nearly four-fifths of all those that blew from all points of the compass; and that in the same period there was only *two days* in which the wind prevailed from any point between west and north-east. This is but an item in the great mass of evidence by which this great circuit or revolution in the atmosphere is established.

ion with the great Archipelago of islands which skirt the northern limit of the Caribean sea. Of these islands, the three largest form an almost perfect and continuous barrier, opposed, obliquely, to the progress of these regular winds. Now as the mass of moving atmosphere presses down upon the islands in its south western progress, and sweeps along their northern coasts, the obstruction which they afford produces a constant tendency to circular evolution in the mass which constitutes the impending or passing current, and which, there is reason to believe, takes full effect upon large portions of the trade wind at successive periods, and especially after the parallel or portion of the trades sweeping north of the islands, becomes narrower by the approach of the autumnal equinox. These masses of atmosphere, thus set into active revolution, continue to sweep along the islands with increased rapidity of gyration till they impinge upon the American coast, or encounter the more regular returning efflux of the trades, or land wind of the North American continent. Gradually assuming a different direction as they recoil from these obstructions and receive new impulsive forces, the stormy masses continue to sweep over, or along the American coast, in a direction conforming, generally, to that coast, or to the direction of the Florida stream, and in conformity also with the prevailing atmospheric current, of which they become an integral part, till they finally become lost, or dissipated, at an unknown distance in the northern Atlantic, or perhaps even reach the coasts of Europe or its northern islands; the particular course of each storm being no doubt modified by the various oblique winds and other incidents which may attend its progress.

That the foregoing is a just account of the formation of the hurricanes and severe storms of the West Indies and the lower latitudes of the North American coast, is strongly confirmed by the fact, that beyond the 12th parallel of latitude, which is a little southward of Barbadoes, hurricanes are never known to occur. The more common origin or source of the autumnal hurricanes is believed to be about the north eastern angle of this great chain of islands; and if we rightly appreciate the operation of these causes, they uniformly tend to produce the rotative movement in the direction which has been recognized, that is, from *right* to *left*, or, in seamen's dialect, *against the sun*. This course of rotation is understood to be contrary to that which is exhibited in the trades which pass southward of the great islands, and which, on reaching the gulf of Mexico incline from left to right, *with the sun*, thus coinciding, or blending, with the returning winds of the North American States and the northern Atlantic, or falling back again upon the trades by a circuitous route.

It appears not improbable that these *hurricane formations*, if this term may be applied to our idea of storms, may sometimes originate at various positions in the great curve between the windward islands of the West Indies, and the capes of North Carolina, and that the more southern and windward formations often diverge to the northward upon a track which, in the lower latitudes, lies eastward of the Floridian current, and producing those severe tempests on the Atlantic, of which we hear only by the occasional reports of our mariners; while those storms of a more leeward origin, or which pursue a more westerly direction, press upon our coast as they advance northward, and thus become more appreciable in their effects, or perhaps visit us with their violence.

The violent hurricanes of the West Indies* having been included in the range of these remarks, it will here be observed, that it is not deemed to be possible, considering the nature of the atmosphere and its constant tendency to an equal distribution, that the wind should blow with very great violence at hardly any place on the globe, unless by means of a circuitous, or revolving motion, in that portion of the atmosphere by which the effect is produced. The position of the axis of revolution may sometimes, however, be horizontal, or may be inclined in any degree from the plane of the horizon, as in the cases which have been alluded to, and as is probably

* It has been supposed by some, that the hurricanes of the West Indies, are but thunderstorms of extraordinary violence, but an acquaintance with the usual phenomena of these hurricanes will lead to a different conclusion. The fact is well established that thunderstorms arise in the west and move in an earterly direction. Hurricanes, on the contrary, first appear in the eastern or southern quarter of the horizon, and advance in a westerly or north-western direction. Violent thunder and lightning is by no means a necessary and uniform attendant on hurricanes, and the gyration of these storms being, as has been shown, chiefly horizontal, is not calculated to produce that sudden and violent admixture of the higher and lower strata which, in the vertical gyration of a thunderstorm, produces such striking electrical effects. In the hurricane, the gradual and uniform depression and contact of the upper region with the lower produce, ordinarily, only those broad flashes of lightning which indicate electrical action upon an extensive surface, with but little energy of action. The passage of a hurricane over a hilly country, or mountainous island, will however, by a disturbance of the general equalibrium, doubtless produce violent thunder and lightning.

It may be added that in the season of hurricanes when the inhabitants of the Caribean Islands can discern *thunder clouds* in the horizon, all immediate apprehensions of a hurricane are at once removed.

the case sometimes with violent winds which blow from off mountains, or high table land. The motions of some parts of the atmosphere which may be immediately contiguous to a storm or a whirlwind, may also be in every intervening state of regularity or confusion. It is believed, however, that all hurricanes and tornadoes must be ascribed to causes analogous to those of which we have taken cognizance. Those which occur in the East Indian seas are well known to attend the changes of the monsoons, where winds moving in different directions, are brought to bear upon each other, or upon the opposing coasts, and the violent rotative effects naturally follow.

The desultory character of this essay, and the nature of the subject treated of, may seem to require some further detail of facts, or circumstances, tending to corroborate the foregoing views, and which will now be given, although the recollections of most persons, and particularly the observations of experienced and intelligent shipmasters, it is believed, will sufficiently establish the leading facts upon which these remarks are grounded. It is to the recorded observations, and careful reports of the members of the laborious and hazardous profession to which we now allude, that the cause of science must be chiefly indebted for an accurate and extensive knowledge of oceanic meteorology.

Some storms of recent occurrence have, from their peculiar violence, excited more than ordinary attention, and the following statements have been selected from the accounts which have been obtained of their locality and progress. The first of these storms which claims our notice, is that which passed the city of New York on the 17th of August last, (1830) being at New York, and along the whole coast north of Hatteras, a *north-east storm.*

This storm, or hurricane, was severe at the island of St. Thomas', on the night between the 12th and 13th of August.

On the afternoon of August 14th, it commenced at the Bahama Islands, and continued during the succeeding night, the wind veering almost round the compass during the existence of the storm.

On the 15th of August, the storm prevailed in the Florida channel, and was very disastrous in its effects.

In Lat. 26° 51′, Lon. 79° 40′, in the Florida stream, the gale was severe on the 15th, from north-north-east to south-west.

Late on the 15th, off St. Augustine, (Florida) in Lat. 29° 58′, Lon. 80° 20′, the gale was very severe.

At St. Andrews', twenty miles north of St. Mary's, (Geo.) from 8, P. M. on the 15th, to 2, A. M. on the 16th, the storm was from an eastern quarter, then changed to south-west, and blew till 8, A.M.

Off Tybee, and at Savannah, (Geo.) on the night of the 15th; changed to north-west at 9, A. M. on the 16th, and blew till 12, M.

At Charleston, (S. C.) on the 16th, the gale was from the south-east and east, till 4, P. M.; then north-east, and round to north-west.

At Wilmington, (N. C.) the storm was from the east, and veered subsequently to the west.

In the interior of North Carolina, the storm was felt at Fayetteville.

In the vicinity of Cape Hatteras, at sea, the storm was very heavy from the south-east, and shifted to north-west.

A vessel bound from New York to Hayti, in the middle or outer part of the gulf stream, about Lat. 33° Lon. 72°, experienced the gale, moderately, from south-west and south-south-west, but with a very heavy sea from a westerly direction, and is supposed to have been on the outer margin of the storm.

Another vessel, at about the same distance from the coast, experienced similar effects.

Early on the morning of the 17th, the gale was felt severely at Norfolk, and also in Chesapeake Bay; from the north-east.

Off the Capes of Virginia, on the 17th, in Lat. 36° 20′, Lon. 74° 2′, "a perfect hurricane" from south to south-south-east, from 5, A. M. to 2, P. M., then shifted to north-west.

On the 17th, in Lat. 37° 30′, Lon. 74° 30′, near the coast of Virginia, the gale was severe at east-north-east, and changed to west-north-west.

Off Chincoteague, (Md.) precise distance from the coast unknown, the gale was severe between south-south-east and north-north-east.

Off the coast of Delaware, in Lat. 38°, Lon. 72°, "tremendous gale," commencing at *south-east*, at 1, P. M. on the 17th, and blowing 6 hours, then changed to *north-west*.

At Cape May, (N. J.) the gale was north-east.

Off Cape May, in Lat. 39°, Lon. 74° 15′, heavy gale from east-north-east, on the afternoon of the 17th August.

Near Egg Harbor, coast of New Jersey, the gale was heavy at north-east on the same afternoon.

Off the same coast, in Lat. 39°, Lon. 73°, the gale was at east-north-east.

In the same latitude, Lon. 70° 30′, "tremendous gale," commencing at south-south-east, and veering to north.

At New York, and on Long Island Sound, the gale was at north-north-east and north-east, on the afternoon and evening of the 17th.

Off Nantucket shoals, at 8, P. M. the gale commenced severe at north-east by east.

In the gulf stream, off Nantucket, in Lat. 38° 15′, Lon. 67° 30′, on the night of the 17th, "tremendous hurricane," commencing at south, and veering, with increasing severity, to south-west, west, and north-west.

At Elizabeth island, Chatham, and Cape Cod, (Mass.) the gale was severe at north-east, on the night between the 17th and 18th.

On the 18th, heavy gale from north-east, at Salem and Newbury-port, Mass.)

Early on the 18th, in Lat. 39° 51′, Lon. 69°, severe gale from *south-east,* suddenly shifting to *north.*

In Lat. 41° 20′, Lon. 66° 25′, "tremendous hurricane" from north-north-east on the 18th of August.

On the night of the 18th, off Sable island, and near the Porpoise bank, in Lat. 43°, Lon. 59° 30′, "tremendous heavy gale" from south and south-west to west, and north-west.

In Lat. 43°, Lon. 58°, severe gale from the south, the manner of change not reported.

This remarkable storm appears to have passed over the whole rout comprised in the foregoing sketch, in about six days, or at an average rate of about seventeen geographical miles per hour.

The duration of the most violent portion of the storm, at the several points over which it passed, may be stated at from seven to twelve hours.

The general width of the track influenced in a greater or less degree by the gale, on the American coast, is estimated to have been from five to six hundred miles.

Width of the hurricane portion of the track, or severe part of the gale, one hundred and fifty to two hundred and fifty miles.

Semi-diameter of the hurricane portion of the storm seventy five to one hundred and twenty five miles.

Rate of the storm's progress from the island of St. Thomas to Providence Island, Bahamas, fifteen nautical miles per hour.

Rate of progress from Providence to St. Johns, Florida, sixteen miles per hour.

From St. Johns to Cape Hatteras, North Carolina, sixteen and a half miles per hour.

From Cape Hatteras to Nantucket, on the south-eastern coast of Massachusetts, eighteen miles per hour.

From Nantucket to Sable Island, off the south-eastern coast of Nova Scotia, twenty miles an hour.

The general rout of this storm is delineated on the annexed map, so far as could be done by a careful collation of accounts from more than seventy different localities. The four dotted lines are supposed to include that portion of the rout on which the storm exhibited its greatest violence, but its entire influence was spread over a much wider range. The two central lines are believed to be an approximation to the rout pursued by the vortex, or moving axis, of the storm.

The storm appeared on this part of the coast simultaneously with the prevalence of a north-westerly wind, which maintained itself at a few miles distance, for some hours after the setting in of the north-east wind at New York; the latter gradually extending itself up the Hudson. During the whole period of the gale the extreme margin of the stratum of clouds pertaining to the storm, was visible from the city and elevated not less than ten or fifteen degrees in the north-western horizon. The sun set during the height of the gale, and by illumining the lower surface of the dense canopy at his departure, gave a most striking degree of splendor to the scene; an effect which was much noticed at New Haven, and other places.

On the western part of the Atlantic ocean, between the parallel of New York and the northern limit of the trades, the prevailing winds, for a considerable period both previously and subsequently to the occurrence of this storm, were south-westerly, or from the southern quarter; and over the whole breadth of the Atlantic on the rout frequented by ships in the European trade, fresh south-western or westerly winds also prevailed at the same period, for many weeks. These facts are well established by numerous marine journals which have been consulted in relation to this subject.

Striking evidence of the vorticular or rotative character of the storm, is afforded by the journals of two of our outward bound European ships, the Britannia and the Illinois. The former had sailed from New York on the 16th, with the wind in a southern quarter, and encountered the storm on the night of the 17th, between Block Island and the latitude of 39°. The storm was first felt from N. E. and E. N. E., and on the course steered by the ship veered by midnight to E. S. E., at which time it was a "perfect hurricane" and the "sea tremendous beyond description." At 4 A. M. of the 18th the wind had veered back to north, and at 8 A. M. to north by west. The Illinois was, on the same night, in the gulf stream, in a south-easterly direction from the Britannia, standing eastward with a fair wind and moonlight, when the *scuds* appeared flying with great swiftness, and the wind, changing to *south*, soon commenced blowing a full hurricane, veering successively, during the night, first to south-west, then to west and to north-west, raging with increased fury till 8 A. M. on the 18th when it abated. It appears evident that this vessel was in the outward or southern semi-diameter of the storm, and that its vortex or axis passed between the two ships. It is also worthy of remark that the Illinois, which was bound from New Orleans to Liverpool, had passed through the Florida channel just previous to the passage of this storm towards the continent, and experienced, from the south, its tremendous swell, while off the coast of South Carolina, but by favor of a fine south-west wind and the current of the gulf stream the ship escaped, for the time being, to be afterwards overtaken by the storm when it had assumed its north-eastwardly course.*

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* Since writing the above, the letter from which the following is an extract has been received from the commander of the Illinois.

I sailed from New Orleans on the 3d of August, bound to Liverpool; nothing worth notice occurred until the 15th, being then in the Gulf Stream, lat. 33° N. lon. 77° W.; winds light in the south-east; experienced a very heavy swell from the south, more than I had ever experienced before in this part, unless preceded by heavy gales. We had no indications of wind at this time, but a dull and heavy appearance in the south. During the night of the 15th the wind shifted round to south south-west, the weather still continuing fine.—By the commencement of the 16th we had a fresh, wholesale breeze, so that with the help of the Gulf Stream, we ran at a great rate, steering north-east; lat. at noon 36°, lon. 73°.—All the 17th the wind continued steady at south south-west, blowing a strong, wholesale breeze; appearance in the south dull and heavy; the sea quite smooth again, and to appearances we had outrun the heavy southerly swell. Lat. at noon 37° 53′, lon. 69° 23′; still continuing to run about the course of the Gulf Stream; temperature of the water 86°.—On the first part of the 18th, (*afternoon of the 17th, current time,*) the wind backed to south and began to *freshen-in* very fast; some heavy clouds arising in the south-west, and likewise observed some small flashes of lightning in that quarter. 8 P. M. the wind had increased to a strong gale; the weather at this time had an unusual appearance, but still it did not look bad; 10 o'clock, the wind still increasing, took in our sails and prepared for the worst; 11 o'clock, the sea ran high and cross, which induced me to heave the ship too under a close-reefed main top-sail. About half past 12, (midnight,) all was darkness; the heavy clouds that had been rising in the south-west had at this time overtaken us; the rain fell in torrents, and

The next storm on which we shall bestow a moment's attention, is that which occurred on the succeding week, which passed New York on the 26th and 27th of August, and which was also on this coast a north-east storm, of about three days duration. From the eastward of the Bahamas it appears to have passed northwardly, between the Florida stream and the Bermudas, and touching the American shore near Cape Hatteras, raged with great fury for about forty hours at each locality, as it swept the great central curve of our coast, and passing from thence, continued its course over George's Bank, in a north-easterly direction. It was evidently of greater compass and slower progress than the preceding storm, as is proved by a collation of the various reports of mariners and its long duration, and its effects were almost equally violent. A few notices only, will be given of the reports of this storm; and we here note the fact, that it is sometimes difficult to determine between current and nautical time, in the dates of marine reports.

August 22d, the gale was experienced off the Bahamas.
" 23d, in lat. 27° 30′, lon. 72°, heavy at E. N. E.
" " " 30° 30′, " 68°, do. do.
" 24th, " 33°, " 65°, tremendous gale at S. E.
" " " 35°, " 70°, heavy gale. [two hours.
" 24th and 25th, off Cape Hatteras, severe gale E. N. E. forty-
" 25th and 26th, lat. 37°, lon. 74°, severe gale N. E. [W.
" " " off Cape May, forty hours, changing to N. and
" " " lat. 38° 30′, lon. 71°, severe at N. E.
" 26th, at Boston and the east coast of Massachusetts, N. E.
" " lat. 41°, lon. 62°, severe at S.

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the lightning was uncommonly vivid; the wind had, in the space of one hour, increased from a moderate gale to a perfect hurricane. Half past 1 A. M. it began to veer to the westward; at 3 A. M. it was west, and rather increased in violence as it shifted. At day light the sky had cleared, but the gale, if any thing, rather increased in its fury; the sea was tremendous and ran in every direction. 7 A. M. the wind had got to the north-west, and at 9 o'clock it began to abate a little in violence. At noon it became moderate enough to steer off our course.—All the 19th, moderate gales at north-west and clear weather. Lat. at noon of the 18th 38° 33′, lon. 66° 30′; lat. on the 19th 39°, lon. 62° 22′; temperature of the water 81°—still continuing in the Gulf Stream.—From this period, (excepting one or two gales from the eastward,) until we arrived at Liverpool, on the 12th of September, we had moderate winds from south south-west to north north-west, with a very smooth sea.—I have only to add, that from an experience of twenty or thirty years, during which time I have been constantly navigating the Atlantic, my mind is fully made up, that heavy winds or hurricanes run in the form of whirlwinds. Yours truly,

Robert Waterman.

This storm pursued, in the early part of its progress, a more northwardly rout, than is usual for those storms that reach the coast, and its rate of progress cannot have greatly exceeded ten miles per hour.*

It may be remembered, that Doctor Franklin has assigned one hundred miles per hour as the average rate of the advance made by north-east storms, *towards* the north-east. As the termination of these storms also follows on from the south-west to north-east, in the same ratio with their commencement, the *direct* effect of this rate of progress would, of itself, be equal to a violent hurricane from *south-west*. The facts which we have exhibited show a very different result, and the discrepancy can be accounted for, only by supposing that in the state of the country at that early period (1740) reports of meteorological facts were too unfrequently and loosely made, to furnish the necessary data for a correct estimate on this subject. The mistake might easily be fallen into in a case like that which we have last mentioned, where a storm of very great extent has fallen obliquely upon the coast; as even a correct report of the

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* The annexed extract from the New York Gazette, comprises some additional facts, and will assist us in forming some just conception of the scenes which are often occasioned by the severe storms of the Atlantic :—

Extracts from the log-book of the ship of war Kensington, W. W. Ramsay, Esq. commander.

Monday, August 23d, Cape Henlopen bearing west-south-west at 7, P. M.; discharged the pilot, and steered off east-south-east.—Tuesday, August 24th, commences with light and variable weather; from 4 to 6, P. M. light airs from the southward; from 6 to 8, nearly calm; from midnight to 4 A. M. moderate and clear—disagreeable head sea; from 4 to 8, A. M. wind fresh from east-north-east; from 8 to meridian freshening, took one reef in the fore and main, and two in the mizen-top-sails.—Wednesday, August 25th, wind high from the north-east—took two reefs in the fore and main-top-sails; from 4 to 6, P. M. fresh gales from the north and east; weather cloudy; sent down royal yards: from 6 to 8, wind increasing; at 7, 40, close reefed the top-sails, reefed the courses, and furled the main-sail; from 8 to midnight, very squally, with rain; at midnight under close-reefed topsails, reefed fore-sail and fore-stay-sail; the second gig washed from the larboard davits; from 4 to 8, A. M. wind not so strong, and hauling to the east.—Thursday, August 26th, fresh gales from north and east, with heavy head sea: attached an eight-inch hawser to the end of the bowsprit; brought both parts into the hawse holes, and set them well up; got a pull of the bobstays and bowsprit shrouds; from 4 to 6 P. M., gale increasing; in sending down topgallant yards lost fore-topgallant-mast and yard; furled the fore-sail, fore and mizen-top-sails; got preventer tackles from the fore-mast to the bowsprit; at 6, Andrew McCormick was washed from the jib-boom and drowned; from 6 to 8, P. M. gale very heavy, the sea increasing to an alarming height; from 8 to midnight, gale most violent; lying to, under close-reefed main-top-sail and fore-time of its first appearance, might show an apparent progress at this high rate between certain points, on or near, the great central curve of our coast.

The two storms next reported to us, took effect on a more eastern portion of the Atlantic. One of these appeared on the 20th of September, pursuing a northerly course in Lat. 39°, Lon. 40°. The other appeared off the south-east border of the great bank of Newfoundland, on the 24th of September, pursuing a north-easterly direction. Both storms exhibited the essential character which we have described, with all the violence of hurricanes.

The next storm which we have occasion to notice, appears to have originated in the vicinity of the Windward Islands, near the close of September, and which, passing the Bermudas on a course somewhat west of north, on its approach to the Florida stream assumed a more easterly course, towards the eastern coast of Newfoundland, or the Grand Bank. Of this storm, which was very disastrous, we shall give a few reports.

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stay-sail. From midnight to 4 A. M. gale raging with great violence—a tremendous sea; at 1, A. M. the main and mizen-topgallant-masts were blown away close to the caps; at 2, A. M. a perfect hurricane from the north, taken aback; the ship in a very critical situation; pitched away the jib-boom, with it the sprit-sail-yard, sprung the bowsprit and fore and main-masts—attempted to relieve the ship of the main-top-sail, weather sheet parting, the sail was instantly thrashed to pieces; at 4, the situation of the ship was most critical, working violently, and much distressed from the weight of her battery; at 4, 30, foresail, fore-top-sail and main-sail burst from their gaskets and were blown into ribbons; from 4 to 8, A. M. gale raging with unabated fury—fore-stay-sail blown from the bolt-rope, and such the force of the storm, that not a rag of canvass could be shown; at 4,40, main-top-mast went by the cap; at 5, fore and main-mast badly sprung, secured the partner wedges with heavy spikes; to save the fore-mast and bowsprit, cut away the fore-top-mast, carrying with it the head of the fore-mast, and part of the fore-top; cock-billed the fore-yard and secured the lee arm to the cable bitts; at 5, 30, carried away weather mainbrace bumpkins; to save the mast, cut away the main-yard, which no human effort could secure; the situation of the ship awful in the extreme; five feet water in the hold, and the crew perfectly paralyzed: the wind had now attained a furious height, and the sea increased to such an alarming degree, that with great difficulty men could be found to cut away the main yard.—Friday, August 27th, gale yet dreadful; at 4, 30, wind hauled to west; set the mizen-stay-sail to keep the ship too; from 4 to 8, gale somewhat abated, set the main-stay-sail; at 6, gale abating, all hands employed in clearing wreck—weather cloudy; from 8 to midnight, moderate, heavy sea, ship very uneasy; from midnight to 4, very heavy sea; from 4 to 8, A. M. gale again increasing. Spoke ship Norfolk, *from Norfolk;* received an offer of assistance. *The Norfolk was not in the gale.*

In Lat. 20° 30′, Lon. 63°, the storm commenced on the 29th of September, at 1, P. M., and continued till half past 6, P. M. from north-east and south-west alternately.

On the same day, in Lat. 22° 46′, Lon. 65°, a hurricane.

Sept. 30th, at night, Lat. 26° 7′, Lon. 66° 31′, "very heavy" five and a half hours.

Oct. 1st, Lat. 30° 38′, Lon. 63°, severe at south-east, shifted to north-west.

" " Lat. 33°, Lon. 66° 30′, severe gale or hurricane.

" " Lat. 34° 9′, Lon. 66° 12′, "hurricane" at east-south-east.

" " Lat. 35°, Lon. 68°, severe gale.

" " Lat. 38°, Lon. 63°, "a hurricane."

" " Lat. 38° 30′, Lon. 57°, severe gale.

" " Lat. 40°, Lon. 61°, hurricane from nearly south, at 2, P. M., sudden and violent from the north.

" " Lat. 40° 25′, Lon. 58° 24′, moderate gale, with heavy swell and cross sea.

" " Lat. 41°, Lon. 55°, very severe.

By an average estimate of dates and distances, it appears to have made progress at the rate of about twenty-seven miles per hour.

A north-east storm, of three days' duration, appeared on our central coast one week subsequent to the foregoing, the rainy, and more tempestuous portion of which continued about twenty-four hours, its progress and other features being analogous to those previously described.

It must not be supposed that the facts which are comprised in the foregoing recitals, are peculiar only to the most violent storms, or to the season of the equinoxes, but the same general features appear to have pertained to every storm which has prevailed in these regions. The extensive hurricane of 1804, which swept over most of the islands in the West Indies, commenced at Martinico on the 3d of September, reached Savannah on the 7th, Boston on the 9th, and became a *snow-storm* on its arrival in the interior of New Hampshire. The great gale of 1815, commenced at St. Bartholomews on the 18th of September, and reached Rhode Island on the morning of the 23d, where it was awfully destructive from the *south-east*, while in the south-eastern part of Massachusetts it was then blowing at *south*, at New London from *east* to south-east, and at New York from *north* to *north-north-west*. The violent north-east snow-storm of December 6th, 1830, swept along our whole coast in the same manner,* it being experienced from the southward and westward, by vessels which were at a certain distance from the coast. It would be easy to fill a volume with the record of facts of a like character, and it is believed that, of the storms of the last forty years, the route and corresponding character of all those which have been sufficiently violent to receive notice in the marine reports, can be traced in a similar manner; while not an instance of a contrary kind has come to our knowledge.

A remission of the south-westerly and westerly winds usually occurs towards the close of the autumnal season, or rather, perhaps, these winds exert their chief force, at this period, on more southern parallels. At this period we often experience a long succession of easterly storms, generally of a sluggish character, and attended with cold rains. This weather sometimes continues into the winter months, and generally occurs again, subsequently to the vernal equinox. Perhaps some of these storms, as well as those of other periods, originate to the northward or *leeward* of the great headlands of our coast, particularly those of North Carolina; but, however originating, the absence of the impulsive effect of a brisk westerly wind, causes them to linger on our shores, to the annoyance of hypochondriacs, and all admirers of a cloudless sky. In some rare instances, the circuit of these north-eastern storms is so great as to sweep, at one and the same time, up the gulf and lower valley of the St. Lawrence, and along our coast, almost to Cape Hatteras, while vessels which are approaching our shores from southern latitudes, encounter the same atmospheric current at west and north-west.

The prevalence of regular winds, generally tends to produce fair weather. By a regular wind is here understood, an atmospheric current of magnitude, which blows, uninterruptedly, in nearly a direct course, without any extraordinary agitation of its parts, or, which blows in a circuit of such extent, as to preserve a similar equability and placidity of movement. At a period subsequent to the vernal equinox, we are sometimes visited by an easterly wind of this character, of no inconsiderable duration. A remarkable instance of the kind occurred in the spring of 1830, when we experienced a regular

* The great snow-storm and gale of January 15, 1831, which occurred after this article was forwarded for publication, exhibited the same character, being a north-east storm on shore, while at a certain distance from the coast, its force was exerted in nearly an opposite direction.

east wind, from even the shores of Europe, and the passage of some returning ships was performed in fifteen or sixteen days, and in some instances, without taking in a top-gallant-sail.* After a little chilliness on the first day or two in which it prevailed, this wind became remarkably bland and agreeable in its effects, in a greater degree, perhaps, than any other winds which we experience at that season. North-easterly storms, of an extensive formation, and with a moderate gyration, are also supposed to blow, occasionally, with a clear sky, towards their marginal portions, for a considerable time, and over a large extent of country; constituting what are somtimes called *dry north easters*, and which, in some places, disappear without producing symptoms of rain.

The gyral axis of a storm in most cases, is probably inclined in the direction of its progress, for, being retarded by the increased resistance of the surface, the more elevated parts of the storm must necessarily be inclined forward and overrun to a very considerable distance the more quiet atmosphere, which lies near the surface. This will account for the first hazy appearance of the storm which is exhibted in the south west, usually on the evening previous to its *setting-in*, and often, some hours previous to any change of wind at the surface.† This overlaying of the higher portion of the storm will account for another premonitory indication which we shall yet have occasion to notice, and thus, also, vessels at sea sometimes encounter the sudden violence of these winds upon their more lofty sails and spars, while all is quiet upon deck. Thus also a balloon sent up in a moderate breeze, has, on ascending a considerable height, been carried off at the rate of seventy miles an hour. The two lateral margins of the advancing storm will also overlay the prevailing

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* On this occasion, London papers were read in New York on the sixteenth day after their publication.

† Dr. Mitchill has recorded as the result of the observation of laboring people in New York, that when the haze or *cirrous* which, appearing at sunset, indicates the approach of a storm, is seen over Staten Island at S. W. or more southerly, the storm of the succeeding day will blow from the *north-east*; but if it appears over the Jersey shore of the Hudson from W. S. W. to N. W. then the storm is expected to blow at *south-east*. These prognostics accord very closely with the views maintained in this article—for as in a S. E. storm, its most advanced and central portion must be over the land, its first appearance will necessarily be exhibited in the western quarter of the horizon—while a north-east storm, the main body of which passes over the ocean, and covers the land with only its north-western limb or margin, will accordingly exhibit its premonitory appearances in a more southerly direction.

current in the same manner, to a less extent, owing to the centrifugal action of the storm; the greatest velocity and force being unquestionably produced at a considerable elevation. These lateral effects or overlayings in the higher portions of the atmosphere often occur, it is believed, without producing any visible influence at the surface. A somewhat contrary effect is usually produced on the receding margin where the prevailing current, or impelling wind, presses heavily upon the advancing mass, and generally overlays it to some extent.

One of the most important deductions which may be drawn from the facts and explications which are now submitted, is an explanation of the causes which produce a fall in the barometer on the approach of a storm. This effect we ascribe to the centrifugal tendency, or action, which pertains to all revolving or rotatory movements, and which must operate with great energy and effect upon so extensive a mass of atmosphere as that which constitutes a storm. Let a cylindrical vessel of any considerable magnitude, be partially filled with water, and let the rotative motion be communicated to the fluid, by passing a rod repeatedly through its mass, in a circular course. In conducting this experiment we shall find that the surface of the fluid immediately becomes depressed by the centrifugal action, except on its exterior portions, where, owing merely to the resistance which is opposed by the sides of the vessel, it will rise above its natural level, the fluid exhibiting the character of a miniature vortex, or whirlpool. Let this experiment be carefully repeated by passing the propelling rod around the exterior of the fluid mass, in continued contact with the sides of the vessel, thus producing the whole rotative impulse by an external force, analogous to that which we suppose to influence the gyration of storms and hurricanes, and we shall still find a corresponding result, beautifully modified, however, by the quiescent properties of the fluid; for instead of the deep and rapid vortex before exhibited, we shall have a concave depression of the surface, of great regularity, and by the aid of a few supended particles, may discover the increased degree of rotation which becomes gradually imparted to the more central portions of the revolving fluid. The last mentioned result obviates the objection, which, at the first view might, perhaps, be considered as opposed to our main conclusion, grounded on the supposed equability of rotation in both the interior and exterior portions of the revolving body, like that which pertains to the rotation of a wheel, or other solid. It is most obvious, however, that all fluid masses are in their gyrations subject to a different law, as is exemplified in the foregoing experiment; and this difference, or departure, from the law of solids is doubtless greater in aeriform fluids than in those of a denser character.

The whole experiment serves to demonstrate, that such an active gyration as we have ascribed to storms, and have proved, as we deem, to appertain to some, at least, of the more violent class, must necessarily expand and spread out, by its centrifugal action, the stratum of atmosphere subject to its influence, and which must consequently become flattened, or depressed, by this lateral movement, particularly towards the vortex or center of the storm, lessening thereby the weight of the incumbent fluid, and producing a consequent fall of the mercury in the barometrical tube. This effect must increase till the gravity of the circumjacent atmosphere, superadded to that of the storm itself, shall, by its counteracting effect, have produced an equilibrium in the two forces. Should there be no overlaying current, in the higher regions, moving in a direction, different from that which contains the storm, as in case of violent storms of great extent there probably is not, the rotative effect may, in these latitudes, be extended into the region of perpetual congelation, till the medium becomes too rare to receive its influence. But, wherever may be the limit of this gyration, its effect must be to depress the cold stratum of the upper atmosphere, particularly towards the more central portions of the storm, and, by thus bringing it in contact with the humid stratum of the surface, to produce a permanent and continuous stratum of clouds, together with a copious supply of rain, or a deposition of congelated vapor, according to the state of temperature prevailing in the lower region.

If the view which has before been taken of the forward inclination of the axis and advancing margin of the storm be well founded, it will result, that on its approach, the barometer will usually be affected previously to any sensible indications of its proximity, especially if the storm be a violent one, and that the sinking of the mercury will continue till the nearest approach of the center of the storm, as existing in the higher parts of the atmosphere. It will also ordinarily happen that, previous to the arrival or passage of the center of rotation, as exhibited at the surface, the mercury will commence rising, and continue its ascent during the approach and prevalence of the last or receding semi-diameter of the storm, even though the violence of the wind, as sometimes happens, should be greater than on its advancing section; the rise of the barometer being accelerated by the impulsion of the general current which presses forward the storm, as well as by the forward inclination of the gyrating mass.

It sometimes happens, when the central portion of an extensive storm passes over or near the point of observation, that the comparative calm or *lull* which prevails about the apparent center of rotation, is preceded by a gradual, rather than sudden, abatement of the wind, and that the seemingly contrary wind of the opposite section of the storm, as gradually resumes its violence. This circumstance, among others, has led to the erroneous conclusion of the prevalence of two distinct and opposing storms, one rapidly succeeding the other, or, as a comparison of facts at different points on the central line of the storm's progress might seem to show, that these supposed separate storms were constantly blowing, each directly against the other. The tendency of such a movement, however, must be to produce an immediate calm, instead of a continued and violent gale, and would inevitably produce a rapid and unnatural rise in the barometer at the first setting in of the storm, a rise which must continue as long as these forces remained opposed to each other. Now as the barometer invariably falls, when under the influence of a violent gale, its testimony ought to be decisive against such a view of the subject, even were it possible to assign any natural cause which would be adequate to furnish the immense and inconceivable power which would be necessary to produce and sustain belligerent movements of such violence and duration. The application of a little physical arithmetic to subjects of this kind, it is conceived, would often prevent the adoption of erroneous or hasty conclusions.

The usual phenomena of these changes, on the central track of the more violent storms of the Atlantic, are however, often exhibited in a manner too sudden and striking, to permit of the illusion of two separate storms to take possession of the mind of the observer; with whatever solution he may attempt to reconcile the apparently opposing effects. Every experienced navigator will shrink with instinctive apprehension from the very idea of those moments of awful and treacherous stillness which place him in the central vortex of the hurricane, ready to be overwhelmed by the rapidly advancing and seemingly impenetrable line of spray which envelops the onset of the last and most dreaded portion of the receding storm.* A spirited and graphic description of this remarkable and well known crisis of a hurricane, constitutes a leading feature in almost every well wrought description of a marine tempest.

We have assumed that the leading storms of the northern and western Atlantic, and the American coast, originate in detached and gyrating portions of the northern margin of the trade winds, occasioned by the oblique obstruction, which is opposed by the islands to the direct progress of this part of the trades, or to the falling in of the northerly and eddy wind from the American coast upon the trades, or to these causes combined. Were it not for the fear of ranging beyond the limits of established data, we might follow out this part of the subject so far as to enquire after the probable influences which indicate or govern the succession of periods in which these aerial masses thus fall into a state of gyration, and the probable effect of this gyration upon each successive portion of the trade wind which may follow in the same course. If we venture on this ground, we would say that the most probable indication of the separations which we suppose to occur from this parallel of the trade, would be found in the diurnal influences to which they are exposed, these being among the most powerful causes which mark the production of meteorological phenomena, or, in other words, that such a portion of the passing atmosphere would be likely to become detached in one body, as should arrive at, or pass a given meridian of the obstruction, in the course of an entire day. The extent of this influence on the atmosphere, if subject to a progressive rate of sixteen miles an hour, which is near the average advance of the storms in that region, would be something short of four hundred miles from east to west,

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* To the southward of Newfoundland, shifts of wind are very common, and it frequently happens that, after blowing a gale upon one point of the compass, the wind suddenly shifts to the opposite point and blows equally strong. It has been known, that while one vessel has been lying-to in a heavy gale of wind, another, not more than thirty leagues distant, has at the very same time been in another gale, equally heavy, and lying-to, with the wind in quite an opposite direction.———In the year 1782, at the time the Ville de Paris, Centaur, Ramilies, and several other ships of war, either foundered or were renderod unserviceable, in lat. 42° 15′, lon. 48° 55′, on or near the Banks, together with a whole fleet of West Indiamen, except five or six, they were all lying-to, with a hurricane from east south-east; the wind shifted, without any warning, to north north-west and blew equally heavy, and every ship lying-to under a square course foundered.—*Purdy's Memoir*, 6*th edition, London*, 1829, *corrected from Medical Repository.*

which corresponds sufficiently with the usual diameter of the lesser storms, and also with the probable breadth, in latitude, of that portion of the trade which, in the stormy season, is subject to this influence. Now the immediate effect of the rotative motion in this mass, will be to induce, in some degree, a counter gyration in the diurnal mass which next succeeds it, and which has not yet become subject to the original rotative influence. The previous tendency, thus imparted, will enable the second diurnal mass to pursue its course along the islands on the following day, in a comparatively quiescent state, which is induced by these contrary influences. But not so with the third diurnal succession of atmosphere, which, previous to its arrival, has perhaps already felt the influence of the counter movement of the second mass, somewhat in the manner in which toothed wheels, by their external contact, communicate motion to each other; and this diurnal mass, thus predisposed, may receive the gyrating impulse with more facility than either of the two which have preceded it. By parity of reasoning, the fourth day would witness the passage of a comparatively undisturbed atmospheric current, while on the fifth day an increased disposition to gyration would again occur, and so alternately, on the succeeding days. These successive diurnal influences, though subject to all the collateral influences which may chance to attend them, may notwithstanding, be supposed to produce some discernable effects, and, in the usually regular progress of these winds towards the continent, and afterwards in the general direction of the coast, these diurnal effects might be supposed distinguishable at a great distance from their original source.

It may happen at some seasons, that the causes which produce the revolving impulsion, operate upon a still larger portion of the atmosphere, equal, we will suppose, to the space occupied in the advance of two days, and some also of three days, as seems to be the case with some extensive storms or hurricanes. Now in most of these cases, whether in periods of one, two, or three days' duration, their termination will coincide at the end of the sixth day.* On the *seventh* day, therefore, a renewal of the original revolving influence, may again be expected to occur. Whatever may be thought

* At St. Augustine, in Florida, where the storms from the vicinity of the islands frequently appear, it is said that a storm which continues more than *one* day, will last *three* days; and this peculiarity, parhaps, continues to be observable till the storm has advanced a much greater distance along the coast, but with less exactitude in proportion to the distance from the place of its origin.

of this hypothesis, there are persons who suppose that in stormy seasons there is, in our climate, a constant tendency to the recurrence of bad weather on the third, fifth and seventh days from the date of a given storm, and this is more particularly noticed on the seventh days, especially when the storm may happen to fall on Sundays. The records of the weather for the more stormy part of the last three years, if carefully examined, will be thought to accord with this opinion, particularly as regards the seventh day storms. These have sometimes occurred for many weeks in succession, and in some cases of failure, have appeared within twelve hours, sooner or later, of the assumed period. If this idea of the subject be well founded, it may be interesting to inquire whether this peculiarity in the weather be not the origin of those diurnal indications, which prevail in some of the febrile diseases of our climate.

The foregoing view of the character of our easterly storms tends to show more clearly the general uniformity and extent of the great atmospheric current of westerly winds, which sweeps over a considerable portion of our continent, and of the Northern Atlantic. It also strengthens the opinion which we have entertained, that these westerly winds, together with the trades which originate them, form but a portion of a great circuit or system of winds, whose revolutions are constantly, though in some parts, irregularly, maintained, in the atmosphere which is incumbent upon the greater part of the Atlantic ocean and a large portion of the adjacent continents; and that this revolution, varying in its sphere with the change of seasons, is kept in constant activity by the causes which produce the trade winds. The same winds produce also in their turn, the great system or circuit, of oceanic currents, comprising the equatorial, the gulf stream, the arctic current, and also their numerous appendant currents, often of a gyrating and varying character, like that of the bay of Biscay. The center of this oceanic revolution is found in that great eddy of the Atlantic which is called the grassy sea, lying between the parallels of 20° and 35° of north latitude, and the 28th and 60th merdians of longitude west from Greenwich. We have the satisfaction to find, on referring to an able and interesting outline of our physical geography and climate, that this great and continued revolution in the atmosphere of the Atlantic basin is supported by irrefragable evidence drawn from a valuable collection of meteorological tables, which have been compiled from numerous observations, made at various points on both sides of the Atlantic.* The same able geographer has shown also in coincidence with the revolution, a general westerly wind or current in the temperate and higher latitudes, connecting the basins of the Pacific and Atlantic, and sweeping entirely across the continents of America, Europe, and part of Asia, and which we find is sustained by numerous authorities. These extensive revolutions, in the great aerial ocean which envelopes our earth, seem to be a benevolent provision of the great author of nature, tending to equalize the climate and temperature of our globe which would otherwise be attended with far greater inequalities.

It appears, also, if the severe storms of the Northern Atlantic pursue a general and somewhat uniform course, that, on receiving intelligence of the occurrence of such a storm, in a particular locality, a probable opinion may be formed of the hazard or exposure of any absent vessel, whose position on the ocean may be known with any good degree of certainty. This shows the importance of particular marine reports, specifying the *latitude and longitude*, *date*, *time of commencement*, *direction*, *duration*, and *subsequent changes* of such storms as may exhibit, either extraordinary violence, or indications of such violence in their immediate vicinity.

In the early stages, or indications of storms upon our coast, it would seem, also, that a pretty correct estimate may be formed of the bearing, and probable course of the *heart of a storm*, and of the course also which, if steered, will have the best tendency to lessen its violence, or duration; and that those navigators who find in any of the more moderate storms, an adverse wind, may, by pursuing a course transverse to that of the storm, often modify its direction in a manner favorable to their wishes.

These remarks are frankly submitted to the consideration of gentlemen of science and observation, who may have means and opportunity for a more accurate and extensive examination of the subject. Any person who may be able to furnish additional facts relating to any of the storms which have been noticed in this article, is respectfully requested to leave a memorandum of the same in the care of Messrs. E. & G. W. Blunt, Hydrographers, in the city of N. York.

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* View of the United States. By William Darby. Philadelphia, 1828. H. S. Tanner. 18mo. pp. 654.—If in addition to the usual tabular records of meteorology, a separate column should be appropriated for noting the course of the clouds, and particularly of those which form the upper stratum, we should obtain evidence, far more conclusive of the prevailing direction of the great atmospheric currents than can be derived from the direction of the winds at the earth's surface.

Art. V.—*Observations on a new variety of Peruvian Bark; with some remarks on the alkaline bases Quinia and Cinchonia;* by George W. Carpenter, of Philadelphia.

Peruvian bark is admitted to be one of the most valuable articles of the materia medica, and there is none in its catalogue, which embraces so great a number of species, and in which there is so great a disparity in the medical qualities of each variety. Under these circumstances, it is peculiarly unfortunate, that the natural history and classification of Cinchona should be so enveloped in ambiguity, the nomenclature of the different species so very defective, and the various writers so discordant in their opinions, as to lead the student through a protracted, and too often fruitless investigation. The attention of our pharmacologists should be particularly directed to the article Cinchona, for the purpose of determining and agreeing upon a specific classification of those species which now occur in commerce, and to establish a nomenclature for them, by which each species and variety could be readily particularized, and at once understood by its name, which is at present impossible. In a preceding volume of this journal, I called the attention of the faculty to this subject, and described the several species of Peruvian bark, which then occurred in commerce, and made the description as accurately as possible from specimens before me. I then suggested as the most appropriate nomenclature, the names of the provinces of South America, from which the different species were collected, as Calisaya, Loxa, &c.—appellations which have been so generally adopted, as to be the most familiar in the language of commerce. The terms Calisaya, Loxa and Carthagena, convey at once the idea of the particular kind of bark, and are perfectly understood, while the terms Lancifolia and Cordifolia, would involve an ambiguity as to what kind of bark was intended, in as much as several varieties of different qualities could come under the same term, and it would be impossible to understand which was intended; for example, the Calisaya and Carthagena, (the former the most superior, and the latter the most inferior species in commerce,) being both yellow bark, would come under the denomination of cordifolia, hence, if cordifolia was ordered, it would be difficult to determine whether the Carthagena or Calisaya was intended, or some intermediate quality.

There has appeared (since my description of Peruvian bark in this Journal,) a species of Cinchona hitherto not observed in our market, and unnoticed by any of the writers on the subject.

Having devoted considerable attention to this valuable article of the materia medica, it is my purpose to furnish, from time to time, as in the present communication, descriptions of any species of Peruvian bark which may be added to those already in commerce, and which has not previously been noticed or understood. This bark, which has been denominated Maracaibo, has been imported in large quantities and the importation is likely to be continued, so that we may calculate upon a regular supply of this bark. It comes from Maracaibo in bales containing generally from seventy to one hundred pounds; hence the name, above adopted, pursuing the arrangement of nomenclature from the locality, as observed in my former paper. This bark is much superior to the Carthagena or common bark as it is generally met with. It produces more than double the amount of saline matter, composed of cinchonine and quinine, and also a larger quantity of extractive matter than the latter; it is therefore, at least, of more than double the value. As this bark can be purchased at the same price, it will become an object in commerce, and it will be advantageous for the practitioner to be acquainted with its distinguishing characters by which he could discriminate and recognize it among the different species and varieties of common bark.

It occurs in flat pieces which are short and broken, as if it were separated from the tree with difficulty, being mostly in pieces from one to three inches in length, and half to one inch broad, and rather thinner than Carthagena bark. There are occasionally found small quills, the longitudinal edges folding together, forming tubes from one fourth to half an inch in diameter. It is of a deep yellow color; the epidermis which is extremely thin, smooth, and of a light grey color, is generally removed from the bark. It may be distinguished from the Carthagena bark by being more compact, and breaking with a short and cleaner fracture, and more particularly by its taste, which is much more bitter, it is quite as strong a bitter as the Loxa bark, but has not the astringency of the latter. The internal layer is fibrous but in a less degree than the Carthagena. This bark has appeared in our market only within a year or two, and as it will supply the place of a much inferior article, it is of high importance to the profession.

The quality of bark depends no doubt, on the proportion of quinine and cinchonine which they respectively contain. The separation of these alkalies, therefore, affords a very valuable test to discover the qualities of different species of bark. Different barks, however, produce with acids various proportions of these two salts. Thus we find the Calisaya produces most quinine, the Loxa most cinchonine, and the red or oblongifolia yields both these salts in nearly equal proportions. What is their comparative value is yet a subject of controversy; a considerable majority of practitioners however, are in favor of the quinine, perhaps because most of them have not had an opportunity of employing the *cinchonine*. Dr. Paris goes so far as to state that cinchonine is only one fifth as active as quinine; others contend for the reverse. An interesting paper read before the Academy of Medicine at Paris, was published in the Bulletin des Sciences Medicales, for November, 1825, in which M. Bally states that he has experimented upon the sulphate of cinchonine, with a view to determine its febrifuge qualities. He administered this sulphate in twenty seven cases of intermittent fevers of different types, in doses of 2 grain pills, giving three or four in the interval of paroxysms, by which treatment he cured the disease as effectually, and as speedily as with the quinine; of which twenty seven cases, there were sixteen tertian, nine quotidian, and two quartan. He remarked further, that the cinchonine has properties less irritating than those of quinine, and that consequently its employment should be more general, and preferred in all simple case. I believe few or no experiments have been made by the physicians of this country upon the medical properties of the cinchonine, and it must consequently be very little known to them from their own experience. It is most certainly a medicine which deserves at least, a trial.

The sulphate of quinine, as generally termed, is not a perfectly neutral salt, being in the state of a sub-sulphate, and is only partly soluble in water. Its exhibition in this fluid is rendered much more eligible, by the addition of a drop of sulphuric acid to each grain of the salt, which makes a perfectly transparent solution, and which I think, from its obvious advantages, must entirely supersede the common formula of gum and sugar; a few grains of citric or tartaric acid will have the same effect as the sulphuric acid, in dissolving the quinine, and these acids have been preferred by some. Dr. Paris states that he lately saw a prescription in which the salt was directed to be rubbed with a few grains of cream of tartar, and then to be dissolved in mint water. This, he continues, is obviously injudicious, since tartaric acid decomposes the sulphate and occasions an insoluble tartrate, which is precipitated. With deference to Dr. Paris, I would beg leave to differ, on the following grounds. The cream of tartar is objectionable, merely from the circumstance that the active part of the compound may be obtained in a more direct and speedy process by the tartaric acid. The combination of cream of tartar and sulphate of quinine, in the above prescription, does produce decomposition, as Dr. Paris has observed, but the virtue of the medicine is not in the least affected by it, and the precipitate, instead of being an insoluble tartrate of quinine, as he observes, is sulphate of potassa; tartrate of quinine is a very soluble salt and is held in solution, while the water becomes slightly turbid, by the precipitation of sulphate of potassa, which however, from its extremely minute division, is speedily taken up by the water, when you have a transparent solution of tartrate of quinine and sulphate of potassa, and as the latter answers neither a good nor a bad purpose, it of course can very conveniently be dispensed with, and therefore, as before stated, the tartaric acid should be preferred, as having a more direct and speedy action.

The high price which the sulphate of quinine has always commanded, and the increasing demand which its reputation has constantly kept up, has been an inducement to fraud; and it is much to be regretted that this valuable article of our materia medica, like others of an expensive kind, has been mixed with foreign substances of inert character, for the base consideration of reducing the cost and enhancing the profit on its sale, and all this at the expense of the health of the suffering patient, to the disappointment of the practitioner, and not unfrequently to the injury of the reputation of the genuine medicine. It is of high importance therefore to be acquainted with the most efficient means of testing its character, where we have any doubt of its purity. The following are the distinctive characters and properties of the sulphate of quinine, and the most simple and effectual method of discovering fraud or adulteration in its composition.*

1. The sulphate of quinine must be soluble, at a moderate heat, in rectified alcohol; if it contains sulphate of lime, soda, potassa, or any

* See observations, communicated by Dr. Faust, on the adulteration of quinine, bark, &c. Vol. XVIII, pp. 81, 84, of this Journal.—*Ed.*

other substance insoluble in alcohol, the adulteration will easily be detected.

2. It is soluble in acidulated water, say one drachm of sulphuric acid to an ounce of water, which will readily dissolve the quinine. By this means, if there is any stearine or margaric acid, (substances prepared expressly for adulterating the article,) they will float on the surface.

3. It should give, by sal ammoniac, a white precipitate, rather flaky, which is soluble in alcohol, and which, on being exposed to a gentle heat, will consume without leaving the least residuum.

4. After having dissolved it in acidulated water, it can be decomposed by means of a little sal ammoniac; it must then be filtered and evaporated. If sugar has been introduced into it, it will be easily detected by the taste or by fire, which will produce its peculiar odor.

5. If a white substance, insoluble in cold water, be found in the sulphate of quinine, heat the mixture to about 170° Fahr. This will render the starch soluble, and its presence may be determined by the addition of an aqueous solution of iodine, which will immediately occasion a blue color, and eventually a blue precipitate. The iodine must be added in very small quantities and very slowly, or the experiment will fail.*

Art. VI.—*Analysis of the Protogæa of Leibnitz;* by Prof. E. Mitchell, of the University of North Carolina.

As any science advances towards perfection, its early history, though not always a matter of great importance, becomes nevertheless an object of interest. In stating the doctrines held by contemporary philosophers, we cannot well avoid some reference to the opinions of those who have preceded us in the same field of investigation and discovery, and if they are mentioned at all, it may well be claimed that the account given of them should be fair and accurate. I have supposed that a *very brief* analysis of the Protogæa of Leibnitz might be acceptable to the readers of the Journal, and

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* Specimens of all the species of Peruvian bark, which now occur in commerce, neatly put up in bottles, with a full description of each and a treatise on Cinchona, can be had, for five dollars, at Geo. W. Carpenter's Chemical Warehouse, Philadelphia.

I am the rather inclined to offer it because of the erroneous character given of that work in a recent geological publication of Prof. Brande.

"Among the correspondents and opponents of Woodward, we meet with several authors whose works are never read, and whose names are falling fast into entire oblivion; there were others of more celebrated memory, and among them Leibnitz, who, towards the end of the 17th century, published his Protogæa, in which there are little more than crude and improbable speculations, relating to the agency of fire upon a supposed chaotic mass."

It may be useful, before proceeding to the proposed analysis, to notice the circumstances which had directed the mind of Leibnitz to the subject of geology, and prepared him for the composition of this work.

No individual of the age in which he lived, had formed so intimate an acquaintance with all the different departments of knowledge. "That extraordinary genius," says Gibbon, speaking of Leibnitz, "embraced and improved the whole circle of human science;"—he remarks however, in another place, that "he may be compared to those heroes whose empire has been lost in the ambition of universal conquest." He had made chemistry a particular object of attention in early life.* On the death of the Elector of Mentz, the Duke of Brunswick Lunenburg became his patron, and establishing himself at Hanover in 1677, the next ten years of his life were spent chiefly in that city. Most of the valuable mines in the Hartz being within the territories of the Duke, who derived a considerable revenue from them, and the successful prosecution of operations there being obstructed by the accumulation of water, the mechanical ingenuity of Leibnitz was put in requisition for creating

* His scheme for acquiring a knowledge of chemistry, had in it perhaps as much of cunning as probity. He heard at Nuremburg, that there was in the city a very secret society of persons engaged in the study of that science and the pursuit of the philosopher's stone. The difficulty was to secure an admission amongst them. He collected from the chemical books the expressions whose meaning he found himself the least able to comprehend, and composed of them a letter wholly unintelligible to himself, which he addressed to the director of the society, demanding, on the ground of the proofs therein exhibited of his extensive knowledge, to be admitted a member of their body. It was not doubted that the author of the letter was an *adept*. He was received with much honor in their laboratory; requested to act as their secretary, and by these methods made himself master of whatever knowledge they possessed.—*Fontenelle's Eloge. Brucker's Philosophy.*

the means of draining them. What was the exact amount of time and thought that he devoted to this object it is perhaps impossible after an interval of a century and a half to determine. It is probable, however, that he was a kind of director or superintendant of mining operations in the Hartz, during a considerable part if not the whole of these ten years. In an application made by him for a post in the service of the Emperor in 1680 or '81, he stated that his attention was much occupied with this business, which however he then hoped would be finished, so far as he was concerned, in the course of a few months. The mountains are about forty miles from Hanover. He had evidently made himself familiar, by personal observation, with the whole district of the Hartz, and with all the processes of mining and metallurgy practised there. The appearances presented in the mines could hardly fail of leading a mind like that of Leibnitz, to some speculations on the causes by which they had been produced, and to the composition of a work like the Protogæa. It is from this quarter that many of his facts and illustrations are drawn. In 1687 he went to Italy, to collect materials for a history of the House of Brunswick, and when in that country did not neglect the opportunity that was offered of prosecuting his geological enquiries and observations.

It appears from a passage in the 19th section, that the Protogæa was composed soon after his return to Hanover, in 1691, when he was forty five years of age. Like most of his other writings, it is a short tract; such as would occupy a space of fifty pages only in this Journal. It is illustrated by twelve plates, prepared by the author, containing representations of shells, ichthyolites, teeth of mammiferæ and other organic remains. A "schediasma" or abstract of the work, (how full I am unable to say, but it is spoken of as containing only "primas lineas"—a mere outline,) was inserted by Leibnitz in the Leipzic Acta Eruditorum, for January, 1693. The Protogæa itself then lay in manuscript till 1749, thirty three years after his death, when it was at length published, with a dull impertinent preface, half as long as the work to which it is attached, by Scheide. From the manner in which the abstract in the Acta Eruditorum is referred to, in two or three places in his letters, it may be conjectured that the author thought well of his performance, and felt a considerable anxiety to learn the opinions of others respecting it.

The Protogæa is divided into forty eight sections or chapters, of which the first five, after the introductory one, aré upon the primeval condition of the globe and the deluge; the next sixteen treat principally of mineral veins and the causes by which they have been produced; thirteen relate to organic remains, especially shells; and the last thirteen to the caverns of the Hartz, amber, alluvium, turf and other miscellaneous matters. A more particular account of the different sections is subjoined.

1. Some reasons are assigned for the composition of the ensuing treatise, as (*a*.) The importance of the subject, giving value to even a moderate acquaintance with it. (*b*.) The enterprise in which he was about to engage, of writing the early history of the House of Brunswick, to which he seems to consider the Protogæa as an appropriate introduction;* so that the merry author of the history of New York, from the creation of the world to the end of the Dutch dynasty, is not without a precedent in the case of this illustrious author. (*c*.) The opportunities afforded by his peculiar situation, for acquiring information upon these subjects.

2. The form of the earth in the beginning was regular and its surface smooth, the mountains being of more recent date; because God makes nothing imperfect and because it was fluid. Its fluidity, which was the effect of heat, is proved by the existence of veins, crystals, and the remains of plants and animals, ("solida intra solidum clausa,") in the rocks.

3. The present aspect of the earth has been produced by conflagrations, succeeded by deluges. It was first a star or body ejected from the sun, lucid by itself, upon whose surface scoriæ were formed; it cooled and ceased to be luminous. This is rendered probable by the circumstance that the rocks and scoriæ from a furnace, are alike convertible by heat into glass, especially if certain salts be added; by which they are proved to have a common basis.

4. The moisture that had hovered in vapor around the hot globe, was condensed as its temperature sank, and being attracted by the ashes or remains of the recent conflagration, formed a lixivium or lye and thus created the salt sea. As the crust of the earth cooled, large cavities were formed in it, by the breaking up of which and the subsidence of the rocky masses, it was diversified with mountains and vallies. The inundations produced by these changes formed the more recent strata.†

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* "Itaque ab antiquissimo nostri tractus statu orsuro dicendum est aliquid de prima facie terrarum."

† "Secutæ inundationes quæ cum deinde rursus sedimenta per intervalla deponerent atque his indurescentibus redeunte mox simili causa strata subinde diversa alia

5. An enumeration of certain mountain ranges, which he supposes to be part of the original skeleton of the globe. He does not deny that smaller conflagrations, earthquakes, and deluges of less extent, have changed the aspect of particular countries. Mankind will decide these things more correctly, when they shall have more accurately examined the surface and strata of the earth.

6. The Deluge. It is proved by the occurrence of marine organic remains upon the mountains. A number of different theories of the *modus operandi*, by which the highest mountains were covered with water, are stated. He prefers the opinion, that the contents of vast caverns in the interior of the earth, were forced out by the falling in of the earth and rocks above, and that these superfluous waters afterwards found their way into other caverns, that had before been empty, and so disappeared.

7. The Brocken, inaccessible during the greater part of the year, and infamous in the surrounding country from concerts of owls, is described. The rivers rising near its summit, are no valid objection to the theory that ascribes them to rain and snow descending from the clouds.

8. The metals are much more abundant in the surrounding mountains of less elevation, than in the Brocken itself. Metallic veins are well defined, as leaves or strata running far into the earth, of moderate thickness and different composition from the rocks in which they lie. They are divided into *pendentes* and *cadentes*, or beds and proper veins; the former of limited extent, the latter descending indefinitely. The effects of their concourse, divarication, etc., are accurately stated. They are ascribed partly to deposits in horizontal beds, which were afterwards shifted into an inclined position, and partly to rifts in the crust of the earth, filled with matter rendered liquid by heat or a solvent. By diligent observation, rules, much superior to those now in use, may be found out for conjecturing the substances lying hid in the bowels of the earth. Vallies have every

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aliis imponerentur facies teneri adhuc orbis sæpius novata est. Donec quiescentibus causis atque æquilibratis consistentior emergeret status rerum. Unde jam duplex origo intellegitur firmorum corporum; una cum ab ignis fusione refrigesceret, altera cum reconcresceret ex solutione aquarum. Neque igitur putandum est lapides ex sola esse fusione. Id enim potissimum de prima tantum massa ac terræ basi accipio. Nec dubito, postea materiam liquidam in superficie telluris procurrentem quiete mox reddita ex ramentis subactis ingentem materiæ vim deposuisse quorum alia varias terræ species formarunt, alia in saxa induruere, e quibus strata diversa sibi superimposita diversas præcipitationum vices atque intervalla testantur."

where been formed by the force of rushing waters or other violence, as is proved by the correspondence of the strata on their opposite sides.

9. For ascertaining the methods pursued by nature in the formation of mineral substances, it would be of advantage to compare them with the results obtained in the laboratory. "*Neque enim aliud est natura quam ars quædam magna.*" He will say nothing respecting the production *de novo* of the metals, or the possibility of the conversion of one metal into another; but places the stories of the regeneration of gold in sands that have been washed, and of the refuse matter of a mine acquiring new riches, on the same footing with those relating to subterranean pigmy miners and the discovery of treasures by means of the divining rod, by men who, if you blindfold them, will not detect the largest and best known veins. Metallic matter is drawn from some old mines in the Hartz, but it is a sediment brought in by water.

10. Native and artificial cinnabar, native zinc from the East Indies and that collected from the furnaces of the Hartz, native calamine and that which, rising in smoke from certain ores, incrusts the same furnaces, are cited as examples of an agreement between the products of nature and those of art.

11. Artificial resemble natural crystals, but the latter, whether produced by the refrigeration of a melted mass, evaporation or sublimation, being the result of a more intense heat than we are able to create, and of a process much longer than ours, are harder and more perfect. The forms of insects and grass, and the liquids sometimes seen in rock crystal, favor the idea that it has been formed from a solution.

12—15. Short and unimportant. Sal ammoniac is raised by natural sublimation and collected near Naples. Native gold and silver have been fused and received a form from the matrix in which they lie. Some mineral substances owe their form to the motion of water alone, as the rounded pebbles found cemented into a rock in the Alps themselves; some are the effect of the combined agency of fire and water.

16. Of tufa, stalactites, and the caverns, whether great or small, in which they are formed—also of a cavern which emitted a vapor that took fire from a candle and burned some of the workman. Toads sometimes found alive in the rocks.

17. Repetition, "Nunc illud absolvamus ut quemadmodum quædam igni soli; alia soli motui aquarum et sedimentis deberi dicimus; ita interdum caloris et aquae junctas operas requiri ostendamus; alicubi variantibus causis ambiguum judicium esse declaremus."

18. Of the copper slates with ichthyolites of Eisleben and Osterode. The number of the ichthyolites, their size, and the accuracy of the delineation, prove them to be real fish and not lusus naturæ. A lake was overwhelmed—the mud enveloping the fish hardened by heat into slate—the animal matter consumed or dissipated, and the metallic matter brought in to supply its place.

19. We are not to be incredulous in regard to the agency of subterranean fire producing the effects here ascribed to it, hardening the strata, fusing the mineral masses, and producing crystals by sublimation and the refrigeration of matter that had been melted or dissolved, inasmuch as earthquakes and volcanoes either now active, as in Italy, or extinct, as on the Moselle, prove the existence of an internal fire.

20. If the idea is preferred that the copper slates have been hardened by time or that they have been produced by a lapidific and metallic vapor, he will not dispute the point, though he considers this opinion less probable—only let it be allowed, that these are real fish and not mere appearances like those of Luther and the Pope shewn at Eisleben, where you would never have discovered the resemblance had it not been pointed out to you.

21. These fish were overwhelmed by some great convulsion. Salt springs as well as shells, are a proof that the sea once covered what is now dry land. Steno's treatise de solido intra solidum is referred to with approbation. Different catastrophes have produced in succession, three different varieties of dry land—the lofty mountains, hills of moderate elevation, and the low level shores of the ocean.

22. As shells are found upon high land, it is has been supposed by some, that the mountains were raised by the elasticity of an interior wind or vapor. Small effects of this kind may have been produced, but so far as the great ranges are concerned, the opinion is inadmissible. Some accounts of the prodigious effects of wind—probably in a great measure fabulous.

23—35. Of organic remains. They have been observed from the most ancient times, and in all parts of Europe. The Spanish ambassador at the court of Persia saw them in the lofty mountains of Caramania. That they are real remains is proved by their variety, shape, color, and other properties which are so well marked, that the species can be studied in the rocks as well as in a cabinet. Some of them are entire and others broken, and sometimes there is merely a cast; they are not therefore, a simple and direct product of nature. They have no roots, but are separated by well defined limits from the rock in which they lie. The more accurately they are examined, the stronger will be the conviction that they are real remains, whereas, the representations of men and buildings sometimes found in the rocks must be viewed at a distance, or the illusion vanishes. Their number, and that the species is not known to exist in the living state as is the case with the cornu Ammonis, is no objection. They may have been accumulated on certain points by currents, and brought from distant regions or the dephts of the sea that have never yet been explored. Analogues of the mineral species are detected in greater numbers as observations are more extended amongst the living races. In proportion as men are more diligent in the business of observation and better acquainted with nature, they are more apt to adopt the opinion espoused by Leibnitz. Such as embrace different views are deceived by the fables of Kircher, Becher and others, who find not only plants and animals but historical facts exhibited in the rocks, and tell of whole fields strewed with the leg bones of giants. These remains are quite distinct from certain crystals that are mentioned, and the other geometry of inanimate nature.* The glossopetra of Luenberg, are described and stated to be shark's teeth and not to differ from those of Malta, that are so much valued for their medicinal properties—they may not be altogether without virtue as a medicine. Sect. 33 is a long enumeration and description from Lachmann of different species of shells.—34. On bones, apparently of the elephant, found in the caves and laid bare by the rivers of Germany. The ivory tusks dug up in Russia and America may belong to the Walrus. If they are real elephant's bones, the habits of the animal or the condition of the earth must have changed, so that the limits beyond which he does not range must be more confined than formerly, or they may have been transported from a distance.—35. Of the remains of an unicorn dug up in Germany—fabulous, judging from the figure, and in bad taste, inasmuch as it violates Horace's rule of not associating discordant organs in the same animal.

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* "Caeteramque omnem naturæ inanimæ geometriam."

36—7. Description of the caves of Scharzfield and Blackenburg in the Hartz with their bones and teeth—" aliqui tantae magnitudinis ut ad nota nobis animalia referri non possunt." The same caves are described by Buckland in his Reliquiæ Diluvianæ.

38. Of amber. The *figures* of leaves, mosses, and insects preserved in it (the substances themselves are wanting,) favor the idea of its vegetable origin.

39—41. Of the alluvium of rivers, etc.—the mouths of the Rhine, the Rhone, the Po, the Nile, with some others, are cited as examples.

42—3. Account of the succession of strata under the town of Mutina in Italy and its wells. After descending nearly seventy feet, a pointed instrument is driven downward, on withdrawing which, the water rises quite to the top and flows over upon the surface of the earth. The ascent is so rapid that the workman is in danger of being drowned; an explanation is given to which it is not necessary for us to attend. As an example of the accumulation of earth in some situations, the well known fact is stated, that we now descend to get into the Pantheon of Agrippa instead of ascending as the Romans did by a number of steps when it was first built.

44—5. Of fossil wood whether petrified or retaining its vegetable character—dug up in Germany and other parts of the world—a simple statement of facts.

46. Of turf—its origin and the manner of preparing and using it—it is reproduced very slowly if it all.

47—8. Of a subterranean forest and the succession of strata observed in digging a well two hundred and thirty two feet in depth, under the town of Amsterdam.

It will be apparent from the above abstract, that Leibnitz does by no means merit the reproaches that have some times been heaped upon him as (at least in this department of knowledge,) a mere visionary system builder. The science of mineralogy was yet to be created when he wrote, and his treatise therefore, contains but little that can be valuable to a geologist of the present day. But its defects are chargeable upon the age in which it was written rather than upon Leibnitz. Good sense, and the indications of patient and accurate observation, pervade every part of it, and we may venture to assert, that if *examined* instead of being *condemned* at hap hazard from its title, it will be found not unworthy of the genius and fame of its illustrious author.

University of North Carolina, Jan. 31st, 1831.

ART. VII.—*On Central Forces;* by Prof. THEODORE STRONG.

(Continued from Vol. XIX. p. 49.)

BY (5) given at p. 48, Vol. XIX, $r=\frac{p'}{1+e\cos. v}$ (1); or, since $p'=a(1-e^2)$, $r=\frac{a(1-e^2)}{1+e\cos. v}$ (2); hence $c'dt=r^2dv=\frac{p'^2dv}{(1+e\cos. v)^2}$ (3). Put $\frac{c'^2}{p'}=g$, and $\sqrt{\frac{g}{a^3}}=n$, then by (3) $ndt=\frac{(1-e^2)^{\frac{3}{2}}dv}{(1+e\cos. v)^2}$ (4); $nt=$ the mean anomaly, $v=$ the true do.; which are here counted from the perihelion. By (2) $dr=\frac{ae(1-e^2)\sin. v\,dv}{(1+e\cos. v)^2}$ and $\sin. v=\frac{a\sqrt{1-e^2}\times\sqrt{e^2-\left(\frac{a-r}{a}\right)^2}}{er}$; hence $ndt=\frac{(1-e^2)^{\frac{3}{2}}dv}{(1+e\cos. v)^2}=\frac{rdr}{a^2\sqrt{e^2-\left(\frac{a-r}{a}\right)^2}}$; put $\frac{a-r}{a}=e\cos.\varphi$ or $r=a(1-e\cos.\varphi)$ (5); then $ndt=(1-e\cos.\varphi)\,d\varphi$ or by integration $nt=\varphi-e\sin.\varphi$ (6); $\varphi=$ the eccentric anomaly, which is supposed to be reckoned from the perihelion: by comparing (2) and (5) $\frac{1-e^2}{1+e\cos. v}=1-e\cos.\varphi$; hence $\tan.\frac{v}{2}=\sqrt{\frac{1+e}{1-e}}\times\tan.\frac{\varphi}{2}$ (7). If $e=1$, the conic section is a parabola; and since $1+\cos. v=2\cos.^2\frac{v}{2}=\frac{2}{1+\tan.^2\frac{v}{2}}$; (1) becomes $r=\frac{p'}{2\cos.^2\frac{v}{2}}=\frac{p'}{2}\left(1+\tan.^2\frac{v}{2}\right)$ (8); and (3) becomes $c'dt=\frac{p'^2}{2}\left(1+\tan.^2\frac{v}{2}\right)d\tan.\frac{v}{2}$, or by integration $c't=\frac{p'^2}{2}\left(\tan.\frac{v}{2}+\frac{\tan.^3\frac{v}{2}}{3}\right)$; put $c't=2A$, then $\frac{p'^2}{4}\left(3\tan.\frac{v}{2}+\tan.^3\frac{v}{2}\right)=3A$ (9). Put $\frac{p'}{4}=q$ and assume $R\cos.\theta=q$, $R\cos.(v-\theta)=\frac{r}{2}$ (10); hence $R=$

$\frac{q}{\cos.\theta}$, and $\frac{q\cos.(v-\theta)}{\cos.\theta}=q\cos.v+q\sin.v\tan.\theta=\frac{r}{2}=q\left(1+\tan.^2\frac{v}{2}\right)$,

or $q\tan.\theta=\frac{q\left(1+\tan.^2\frac{v}{2}-\cos.v\right)}{\sin.v}=\frac{q}{2}\left(3\tan.\frac{v}{2}+\tan.^3\frac{v}{2}\right)$, or by (9) $q\tan.\theta=\frac{3A}{2p'}$ (11). (11) agrees with Newton's construction, (Prin. Vol. I, Sec. VI, prop. 30.) his $M=\frac{A}{2p'}$, and $q\tan.\theta=$ his $GH=3M$. Let $p=$ the semi circumference of a circle rad. being 1, then if $v=\frac{p}{2}$, $\tan.\frac{v}{2}=1$, and A becomes $\frac{p'^2}{3}$; hence $\frac{3A}{2p'}:\frac{p'}{2}::A:\frac{p^2}{3}$, which agrees with Newton's proportion in cor. 1. and $q\tan.\theta=\frac{3A}{2p'}$ $=\frac{3c't}{4p'}$ gives $\frac{d(q\tan.\theta)}{dt}=\frac{3c'}{8\times\frac{p'}{2}}=\frac{3V}{8}$ (V= the velocity of the particle at the vertex;) or $\frac{d(q\tan.\theta)}{dt}:V::3:8$, which is his proportion in cor. 2. and his cor. 3 is evident by (10) which are assumed on the supposition that a circle is described through the points A, S, P, in his figure; its centre H being at the intersection of GH and a perpendicular erected at the middle of SP or r, its radius SH=R, GS=q, HSG=θ, ASP=v, ∴HSP=$v-\theta$.

Let r, v, t, A, become r', v', t', A'; then by (8) $r'=\frac{p'}{2\cos.^2\frac{v'}{2}}=\frac{p'}{2}\left(1+\tan.^2\frac{v'}{2}\right)$ (12); and by (9) $\frac{p'^2}{4}\left(3\tan.\frac{v'}{2}+\tan.^3\frac{v'}{2}\right)=3A'$ (13); by subtracting (9) from (13), resolving the remainder into factors, and putting for $1+\tan.^2\frac{v}{2}$, $1+\tan.^2\frac{v'}{2}$, their respective equals $\frac{2r}{p'}$, $\frac{2r'}{p'}$ as given by (8) and (12); there results $\frac{p'}{2}\left(\tan.\frac{v'}{2}-\tan.\frac{v}{2}\right)\times\left(r'+r+\frac{p'}{2}(1+\tan.\frac{v'}{2}\tan.\frac{v}{2})\right)=3(A'-A)$ (14). Put $v'-v=2u$ and let $c=$ the chord connecting the extremities of r', r, and $r'+r+c=2m$, $r'+r-c=2n$ ∴ $r'+r=m+n$; (by trig.) $c^2=r'^2+r^2-2r'r\cos.2u$, or since $\cos.2u=2\cos.^2u-1$, $c^2=(r'+r)^2-$

$4r'r\cos.^2u\ .\cdot.\ (r'+r)^2-c^2=4mn=4r'r\cos.^2u=\frac{p'^2\cos.^2u}{\cos.^2\frac{v'}{2}\cos.^2\frac{v}{2}}$ by (8) and (12); or $\frac{p'}{2}\left(1+\tan.\frac{v'}{2}\tan.\frac{v}{2}\right)=\sqrt{mn}$; also $m+n-2\sqrt{mn}=(\sqrt{m}-\sqrt{n})^2=r'+r-2\sqrt{mn}=\frac{p'}{2}\left(1+\tan.^2\frac{v'}{2}+1+\tan.^2\frac{v}{2}\right)-p'\left(1+\tan.\frac{v'}{2}\tan.\frac{v}{2}\right)=\frac{p'}{2}\left(\tan.\frac{v'}{2}-\tan.\frac{v}{2}\right)^2$; or $(\sqrt{m}-\sqrt{n})\times\sqrt{\frac{p'}{2}}=\frac{p'}{2}\left(\tan.\frac{v'}{2}-\tan.\frac{v}{2}\right)$. By substituting the values thus found in terms of m and n, in (14), it becomes $\sqrt{\frac{p'}{2}}\times(m^{\frac{3}{2}}-n^{\frac{3}{2}})=3(A'-A)$; hence by restoring the values of A′, A, m, n, and putting $\frac{c'^2}{p'}=g$ I have $t'-t=\frac{(r'+r+c)^{\frac{3}{2}}-(r'+r-c)^{\frac{3}{2}}}{6\sqrt{g}}$ (15); (See Mec. Anal. Vol. II, p. 31.)

Suppose $e\angle 1$, then the conic section is an ellipse; $a=$ its semi transverse axis, and $e=$ its focal distance $\div a$. (6) is easily changed to $nt=\frac{e}{a}\left(\frac{a\varphi}{e}-a\sin.\varphi\right)$, or since n, e, a, are the same at all points of the curve, t is as $\frac{a\varphi}{e}-a\sin.\varphi$; which indicates Newton's construction, (Prin. Vol. I, Sec. VI, prop. 31,) for $e=\frac{SO}{AO}$ in his figure, $a=AO$, $.\cdot.\frac{a}{e}=\frac{AO^2}{SO}=$ his OG, and $\varphi=$ angleAOQ $.\cdot.\frac{a\varphi}{e}=OG\times\varphi=$ arc GF, also $a\sin.\varphi=AO\times\sin.AOQ=\sin.AQ$ (to rad. AO;) $.\cdot.\frac{a\varphi}{e}-a\sin.\varphi=GF-\sin.AQ=GK$, or t is as GK. Put in (6) $\varphi=\varphi'+x(x=$ a small arc) then $nt=\varphi'+x-e\sin.(\varphi'+x)=\varphi'+x-e\sin.\varphi'-xe\cos.\varphi'\ .\cdot.\ x=\frac{nt-\varphi'+e\sin.\varphi'}{1-e\cos.\varphi'}$ neglecting terms which involve x^2, x^3, &c.; or if x°, nt°, φ'°, R°, denote the degrees in x, nt, φ', and an arc of a circle equal to its radius, $x^{\circ}=\frac{nt^{\circ}-\varphi'^{\circ}+eR^{\circ}\sin.\varphi'}{1-e\cos.\varphi'}$ (16). (16) agrees with the first method of approximation given in the scholium to the 31st proposition; for $nt^{\circ}=N$, $\varphi'^{\circ}=AOQ$, $eR^{\circ}=$

his B, for $e=\frac{SO}{AO}$ (see his fig.) $\therefore$ AO : SO : : R° : eR° which agrees with his proportion for finding B; also his $L=\frac{R}{e}$ (R= his radius;) $\therefore L : L-R\cos.\varphi' : : \frac{R}{e} : \frac{R}{e}-R\cos.\varphi' : : 1 : 1-e\cos.\varphi'$; and by (16) $1-e\cos.\varphi' : 1 : : nt^{\circ}-\varphi'^{\circ}+eR^{\circ}\sin.\varphi' : x^{\circ}$, which agrees with his proportion for finding E, $\therefore$ his $E=x^{\circ}$. By adding x° to φ'° and repeating the operation with the corrected value of φ'°, the second part of his process will be obtained, and so on; observing that the successive corrections are to be applied according to their algebraic signs; and that the sign of $e\cos.\varphi'$ in the denominator of (16) must be changed into + when φ'° is between 90° and 270°, also the sign of $eR^{\circ}\sin.\varphi'$ must be changed into − when φ'° is between 180° and 360°, because $\cos.\varphi'$ is negative in the former of these cases, and $\sin.\varphi'$ in the latter; when φ is found, v is easily found also by (7). By changing the sign of $e\cos.v$ in the denominator of (2) it becomes $r=\frac{a(1-e^2)}{1-e\cos.v}$ (17); v being counted from the aphelion. Put $2a-r=r'$, then $r'=$ the distance of the particle, which is supposed to describe the ellipse, from the other focus; let $v'=$ the angle made by r' and the distance of that focus from the nearer vertex, then $r'=\frac{a(1-e^2)}{1+e\cos.v'}$ (18); and because r, r' make equal angles with the tangent at the place of the particle $rdv=r'dv'$, or $r^2dv=c'dt=rr'dv'$ (19). By (18) $r=2a-r'=\frac{a+2ae\cos.v'+ae^2}{1+e\cos.v'}$, and $c'dt=\sqrt{gp'}\times dt=\sqrt{ag(1-e^2)}\times dt$; by substituting these values, and that of r' as given by (18), in (19) and reducing, I have $\frac{(1+2e\cos.v'+e^2)\times\sqrt{1-e^2}\times dv',}{(1+e\cos.v')^2}=\sqrt{\frac{g}{a^3}}\times dt=ndt$; or $dv'=ndt\times\left(\frac{1+2e\cos.v'+e^2\cos.^2v'}{1+2e\cos.v'+e^2}\right)\times(1-e^2)^{-\frac{1}{2}}$, or since $\cos.^2v'=\frac{1+\cos.2v'}{2}$ by rejecting quantities of the order e^4, e^5, &c. I have $dv'=\left(1+\frac{e^2}{2}\cos.2v'+e^3(\cos.v'-\cos.v'\cos.2v')\right)\times ndt$; by known formulæ $\cos.v'\cos.2v'=\frac{\cos.3v'+\cos.v'}{2}$; hence and by neglecting quantities of the order e^4, &c. $dv' = \left(1+\frac{e^2}{2}\cos. 2nt+\frac{e^3}{2}(\cos. nt-\cos. 3nt)\right)\times ndt$, or by integration $v'=nt+\frac{e^2}{4}\sin. 2nt+\frac{e^3}{2}\left(\sin. nt-\frac{\sin. 3nt}{3}\right)$, but $\sin. nt-\frac{\sin. 3nt}{3}=\frac{4}{3}\sin.^3 nt$; $\therefore v'=nt+\frac{e^2}{4}\sin. 2nt+\frac{2e^3}{3}\sin.^3 nt$ (20). Put $ap'=c^2$, then, since $p'=a(1-e^2)$, $c^2=a^2(1-e^2)$, or $c=a\left(1-\frac{e^2}{2}\right)$ neglecting quantities of the order e^4, e^6, &c. or $2c=a+a(1-e^2)=a+p'$; hence by putting $c-p'=\text{D}$, I have $a-c=\text{D}$, $a^2-c^2=a^2e^2=(a+c)\text{D}$, $\therefore \frac{e^2}{4}=\frac{(a+c)\text{D}}{4a^2}$, $\frac{2}{3}e^3=\frac{2(a+c)e\text{D}}{3a^2}=\frac{4e\text{D}}{3a}$ nearly. Let $\frac{(a+c)\text{D}}{4a^2}=\sin. \text{Y}=\text{Y}$ nearly, $\frac{4e\text{D}}{3a}=\sin. Z=Z$ nearly, (Y and Z being small angles;) Y $\sin. 2nt=\text{V}$, $Z\sin.^3 nt=\text{X}$; then (20) becomes $v'=nt+\text{X}+\text{V}$, which agrees with the second method of approximation given in the scholium; Newton's $\frac{\text{L}}{2}=p'$, DO$=c$, AO$=a$, PHB$=v'$, PSB$=v$, and the angles X, V, are the same as his X, V. Again by (4), $\frac{dv}{ndt}=(1+e\cos. v)^2\times(1-e^2)^{-\frac{3}{2}}$ also by (2) and (5), $\frac{1+e\cos. v}{1-e^2}=\frac{1}{1-e\cos. \varphi}$; hence $\frac{dv}{ndt}=\frac{(1-e^2)^{\frac{1}{2}}}{(1-e\cos. \varphi)^2}$ and, since $ndt=(1-e\cos. \varphi)d\varphi$; $\left(\frac{d\varphi}{ndt}\right)^2=\frac{1}{(1-e\cos. \varphi)^2}$, $\therefore \frac{dv}{ndt}=\left(\frac{d\varphi}{ndt}\right)^2\times(1-e^2)^{\frac{1}{2}}$ (21).

I will now investigate a general formula, which will enable me to find v in terms of nt by (21). Let $\text{Q}=\text{F}y=$ any function of y, and $y=$ any function of x; (x being a small variable quantity;) then is Q a function of x, which can generally be expressed by a series of the form $\text{Q}=\text{Q}'+x\text{Q}_1+x^2\text{Q}_2+x^3\text{Q}_3\ldots+x^n\text{Q}_n+x^{n+1}\text{Q}_{n+1}+$ etc. (a); Q', Q_1, Q_2, &c. being independent of x. Put $x=0$, then (a) becomes $\text{Q}=\text{Q}'$, $\therefore \text{Q}'=$ the value of Q when $x=0$; and by taking the differential of (a) n times relatively to x, (supposing dx constant,) I have $\frac{d^n\text{Q}}{dx^n}=1.2.3\ldots n\text{Q}_n+2.3\ldots(n+1)x\text{Q}_{n+1}+$ etc. (b); by putting

$x=0$ in (b), I have $Q_n = \frac{d^nQ'}{1.2.3...ndx^n}$ for the general form of the quantities $Q_1, Q_2...Q_n$ etc.; $\left(\frac{d^nQ'}{1.2.3...ndx^n} = \text{the value of } \frac{d^nQ}{1.2.3...ndx^n}\right.$ when $\left.x=0;\right)$ let $n=1, 2, 3, 4$, and so on successively, then $Q_1 = \frac{dQ'}{dx}$, $Q_2 = \frac{d^2Q'}{1.2dx^2}$, $Q_3 = \frac{d^3Q'}{1.2.3dx^3}$, and so on; by substituting these values of Q_1, Q_2, &c. in (a) it becomes $Q = Q' + x \cdot \frac{dQ'}{dx} + \frac{x^2}{1.2} \cdot \frac{d^2Q'}{dx^2} + \frac{x^3}{1.2.3} \cdot \frac{d^3Q'}{dx^3} + \text{etc.}$ (c). Let $r = fy =$ any function of y; and $y = \psi(u+xr)$ (d), $=$ any function of $u+xr$; then if (d) is solved with respect to y, y will equal a function of u and x, but as there is no given relation between u and x they are independent variables; also $Q = Fy =$ a function of u and x. Again, (by solving (d) with respect to $u+xr$;) $u+xr =$ a function of y, let z denote this function; then (d) becomes $z = u+xr$ (e). The differential of (e) with respect to u, gives $\frac{dz}{dy} \times \frac{dy}{du} = 1 + x\frac{dr}{dy} \times \frac{dy}{du}$, and its differential relatively to x, gives $\frac{dz}{dy} \times \frac{dy}{dx} = r + x\frac{dr}{dy} \times \frac{dy}{dx}$; hence $\frac{dy}{dx} = r \cdot \frac{dy}{du}$ (f); and $\frac{dQ}{dx} = \frac{dQ}{dy} \times \frac{dy}{dx}$; but, by (f), $\frac{dQ}{dy} \times \frac{dy}{dx} = r \times \frac{dQ}{dy} \times \frac{dy}{du} = \left(\text{since } \frac{dQ}{dy} \times \frac{dy}{du} = \frac{dQ}{du},\right) r \cdot \frac{dQ}{du}$; hence $\frac{dQ}{dx} = r \cdot \frac{dQ}{du}$ (g). Let $R =$ any function of r; then $R =$ a function of $y =$ a function of u and x; hence $\frac{d\left(R \cdot \frac{dQ}{du}\right)}{dx} = \frac{dR}{dy} \times \frac{dy}{dx} \times \frac{dQ}{du} + R.\frac{d\left(\frac{dQ}{du}\right)}{dx} = \frac{dR}{dy} \times \frac{dy}{du} \times \frac{dQ}{dy} \times \frac{dy}{dx} + R.\frac{d\left(\frac{dQ}{dx}\right)}{du} = \frac{d\left(R \cdot \frac{dQ}{dx}\right)}{du}$ (h). Now by (g) I have $\frac{d^2Q}{dx^2} = \frac{d\left(r \cdot \frac{dQ}{du}\right)}{dx} = \frac{d\left(r \cdot \frac{dQ}{dx}\right)}{du}$ by (h); but by (g) $\frac{dQ}{dx} = r \cdot \frac{dQ}{du}$, $\therefore \frac{d^2Q}{dx^2} = \frac{d\left(r^2 \cdot \frac{dQ}{du}\right)}{du}$; and $\frac{d^3Q}{dx^3} = \frac{d^2\left(r^2 \cdot \frac{dQ}{du}\right)}{dx.du} = \frac{d^2\left(r^2 \cdot \frac{dQ}{dx}\right)}{du^2}$ by (h); or, by (g),

$\frac{d^3Q}{dx^3}=\frac{d^2\left(r^3.\frac{dQ}{du}\right)}{du^2}$; hence generally $\frac{d^nQ}{dx^n}=\frac{d^{n-1}\left(r^n.\frac{dQ}{du}\right)}{du^{n-1}}$; and $\frac{d^nQ'}{dx^n}$ $=\frac{d^{n-1}\left(r'^n.\frac{dQ'}{du}\right)}{du^{n-1}}$ (i); r', $\frac{dQ'}{du}$ being the values of r, $\frac{dQ}{du}$ when $x=0$.

Let $n=1, 2, 3,$ and so on successively in (i); then $\frac{dQ'}{dx}=r'.\frac{dQ'}{du}$, $\frac{d^2Q'}{dx^2}=\frac{d\left(r'^2.\frac{dQ'}{du}\right)}{du}$, $\frac{d^3Q'}{dx^3}=\frac{d^2\left(r'^3.\frac{dQ'}{du}\right)}{du^2}$, and so on; by substituting these values of $\frac{dQ'}{dx}, \frac{d^2Q'}{dx^2}, \frac{d^3Q'}{dx^3}$, &c. in (c) it becomes $Q=Q'+x.\left(r'.\frac{dQ'}{du}\right)$ $+\frac{x^2}{1.2}.\frac{d\left(r'^2.\frac{dQ'}{du}\right)}{du}+\frac{x^3}{1.2.3}.\frac{d^2\left(r'^3.\frac{dQ'}{du}\right)}{du^2}+$ etc. (k); put $x=0$ in (d), then $y=\psi u$, and $Fy=F(\psi u)=Q'$; this value of Q', when substituted in (k) gives the general formula which I proposed to find; (see Mec. Cel. Vol. I, p. 173.) If $\psi=1$, or $y=u+xr$, then $Q=Fy$, $Q'=Fu$, $r'=fu=$ the value of fy when $x=0$, and $\frac{dQ'}{du}=\frac{dFu}{du}$; hence (k) becomes

$$Fy=Fu+x.\left(r'.\frac{dFu}{du}\right)+\frac{x^2}{1.2}.\frac{d\left(r'^2.\frac{dFu}{du}\right)}{du}+\frac{x^3}{1.2.3}.\frac{d^2\left(r'^3.\frac{dFu}{du}\right)}{du^2}+$$

etc. (l); if $F=1$, or $Fy=y$, then $Q'=Fu=u$, and $\frac{dFu}{du}=\frac{du}{du}=1$; hence (l) becomes $y=u+x.r'+\frac{x^2}{1.2}.\frac{dr'^2}{du}+\frac{x^3}{1.2.3}.\frac{d^2r'^3}{du^2}+$ etc. (m); (see Mec. Anal. Vol. II, p. 22.) If $fy=1$, $r'=1$, and $y=u+xfy$ becomes $y=u+x$, and $Fy=F(u+x)$; hence (l) becomes $F(u+x)$ $=Fu+x.\frac{dFu}{du}+\frac{x^2}{1.2}.\frac{d^2Fu}{du^2}+\frac{x^3}{1.2.3}.\frac{d^3Fu}{du^3}+$ etc. (n); this formula is usually known by the name of Taylor's theorem, and it may also be observed that (c) is usually called Maclaurin's theorem; (see La Croix's Traité élémentaire de Calcul Différentiel, etc. pp. 27, 29.) Now by (6) I have $\varphi=nt+e\sin.\varphi$, which agrees with $y=u+xfy$ by making $y=\varphi$, $fy=\sin.\varphi$, $u=nt$, $x=e$; put $\frac{dFnt}{ndt}=F'nt$, then $Fu=$ Fnt, and $\frac{dFu}{du}=F'nt$, $r'=fu=\sin.nt$; by substituting these values in (l) it becomes $F\varphi = Fnt + e(F'nt.\sin.nt) + \frac{e^2}{1.2}\cdot\frac{d(F'nt.\sin.^2nt)}{ndt} + \frac{e^3}{1.2.3}\cdot\frac{d^2(F'nt.\sin.^3nt)}{n^2dt^2}$ + etc. (o); which agrees with (q) given at page 177, Vol. I, Mec. Cel. Let $F=1$, then $F\varphi=\varphi$, $Fnt=nt$, and $F'nt=1$; hence (o) becomes $\varphi = nt + e\sin.nt + \frac{e^2}{1.2}\cdot\frac{d(\sin.^2nt)}{ndt} + \frac{e^3}{1.2.3}\cdot\frac{d^2(\sin.^3nt)}{n^2dt^2}$ + etc. (p); this formula is found immediately by (m), by changing y into φ, u into nt, x into e, and r' into $\sin.nt$.

By taking the differential of (p) I have $\frac{d\varphi}{ndt} = 1 + e\cos.nt + \frac{e^2}{1.2}\cdot\frac{d^2(\sin.^2nt)}{n^2dt^2} + \frac{e^3}{1.2.3}\cdot\frac{d^3(\sin.^3nt)}{n^3dt^3}$ + etc. (q); substituting in (q) for $\sin.^2nt$, $\sin.^3nt$, &c. their values, (see La Croix's Traité de Calcul Différentiel, etc. p. 314,) taking the differentials, (as indicated by the formula, making ndt constant,) and by rejecting those terms which involve powers of e higher than e^6, I have $\frac{d\varphi}{ndt} = 1 + e\cos.nt + e^2\cos.2nt + \frac{e^3}{8}(9\cos.3nt - \cos.nt) + \frac{e^4}{3}(4\cos.4nt - \cos.2nt) + \frac{e^5}{384}(625\cos.5nt - 243\cos.3nt + 2\cos.nt) + \frac{e^6}{120}(243\cos.6nt - 128\cos.4nt + 5\cos.2nt)$ (r). It may be observed that $\frac{d\varphi}{ndt}$ can also be found immediately by the value of u, (given in the Mecanique Celeste, Vol. I, p. 179,) viz. by taking the differential and then dividing both sides of the equation by ndt, and $\frac{du}{ndt}$ will be found to be the same as the value of $\frac{d\varphi}{ndt}$ given by (r), as it evidently ought to be, for his u denotes the same thing as φ. Now by (21) $\frac{dv}{ndt} = \left(\frac{d\varphi}{ndt}\right)^2 \times (1-e^2)^{\frac{1}{2}}$; hence by taking the square of $\frac{d\varphi}{ndt}$, as given by (r), neglecting those terms which involve e^7, e^8, &c. then multiplying by $(1-e^2)^{\frac{1}{2}}$, (observing that the terms which involve e^7, e^8, &c. are to be neglected as before,) and I have $\frac{dv}{ndt} = 1 + \left(2e - \frac{e^3}{4} + \frac{5}{96}e^5\right)$

$\cos. nt + \left(\frac{5}{2}e^2 - \frac{11}{12}e^4 + \frac{17}{96}e^6\right) \times \cos. 2nt + \left(\frac{13}{4}e^3 - \frac{129}{64}e^5\right) \cos. 3nt$ $+ \left(\frac{103}{24}e^4 - \frac{451}{120}e^6\right) \cos. 4nt + \frac{1097}{192}e^5 \cos. 5nt + \frac{1223}{160}e^6 \cos. 6nt$; multiplying by ndt and then taking the integral, I have $v = nt + \left(2e - \frac{e^3}{4} + \frac{5}{96}e^5\right) \sin. nt + \left(\frac{5}{4}e^2 - \frac{11}{24}e^4 + \frac{17}{192}e^6\right) \sin. 2nt + \left(\frac{13}{12}e^3 - \frac{43}{64}e^5\right) \sin. 3nt + \left(\frac{103}{96}e^4 - \frac{451}{480}e^6\right) \sin. 4nt + \frac{1097}{960}e^5 \sin. 5nt + \frac{1223}{960}e^6 \sin. 6nt$ (s); this value of v is the same that La Place has found at page 181, Vol. I. of the Mecanique Celeste, and if I am not greatly deceived the method which I have used is altogether more simple and easy than his. Again v is easily calculated by Newton's method of repeated substitutions; for (4) is easily changed to $dv = ndt \times \left(1 + \frac{e^2}{2} + 2e \cos. v + \frac{e^2}{2} \cos. 2v\right) \times (1 - e^2)^{-\frac{3}{2}}$ (t); if $e = 0$, $v = nt$, and $\cos. v = \cos. nt$, this value of $\cos. v$ when substituted in (t) gives, by neglecting quantities of the orders e^2, e^3, &c. $dv = ndt \times (1 + 2e \cos. nt)$, or by integration $v = nt + 2e \sin. nt$; this value of v when substituted in $\cos. v$, $\cos. 2v$, by rejecting quantities of the orders e^3, e^4, &c. gives $dv = ndt \times \left(1 + 2e \cos. nt + \frac{5}{2}e^2 \cos. 2nt\right)$ and by integration $v = nt + 2e \sin. nt + \frac{5}{4}e^2 \sin. 2nt$; by substituting this value of v in $\cos. v$, $\cos. 2v$, and neglecting terms which involve e^4, e^5, &c. I have $v = nt + \left(2e - \frac{e^3}{4}\right) \sin. nt + \frac{5}{4}e^2 \sin. 2nt + \frac{13}{12}e^3 \sin. 3nt$, and by repeating the process for the fourth powers of e, then for the fifth powers, and then for the sixth powers the same value of v will be found as given by (s); but this method, although very simple for a few of the first terms of the series, becomes ultimately very laborious.

Art. VIII.—*Continuation of the Essay on the Transition Rocks of the Cataraqui; by* Capt. R. H. Bonnycastle, R. E. Up. Can. (With figures—see the plate.)

(Continued from Vol. XVIII, p. 104.)

In proceeding eastward from the hill on which the curious tablets above mentioned lay, like monumental records of animal races, whose very existence would have been otherwise unknown, we pass over a rough and uneven portion of the limestone country, where Earthquake appears to have partially exerted his giant power, and here is discovered another singular and, as far as I am aware, unusual disposition of the calcareous rock.

In the upper parts of the denuded beds, at certain points, as, for instance, at a short distance in front of the road which crosses Point Henry and at about one hundred and ten feet above the level of the lake, where the layers have been disunited in searching for quarries, a sort of faintly marked Ludus Helmontii, resolvable into a series of finely graven wavy septaria, may be discovered on the flat and weather-worn surfaces.

These septarian lines, depicted thus on the tabular surfaces, are surrounded by undulations, through which the stone is roughened into a continuity of little knobs and cups, which a smart blow causes to separate along the tortuous lines of the wavy septæ, and discloses a beautiful series of extremely delicate and minute columns, which penetrate, in some instances five or six inches, into the layer of stone, but more commonly only to the depth of half an inch or an inch.

These acicular columns, or rather flutings, are perpendicular to the plane of the bed, and are generally terminated by a folding, as it were, of their inferior extremities into a crater, whilst however, the needles or fibres retain their parallelism, which they, invariably, preserve throughout their vertical position. The crater, or cup-shaped termination is thicker as its hemisphere approaches its lowest part, whilst the hair-like prisms are every where else very thin, and indeed, are a mere coating to the limestone they envelope. These flutings are sometimes very deeply channeled, at others the specimen has the outward look of an imperfect prism or cylinder.*

* I have one large piece, of which a drawing is subjoined, (see the plate,) which when reversed, or placed on the natural flat surface, originally uppermost, looks like two fluted towers, joined by a fluted barbican, and crowned by rounded roofs; the total height is about three inches, the total length near five and the thickness nearly two.

The color of this coating is that of beautiful and fine dark brown hair, a little oiled, when the specimen is first exposed to the air, but it does not retain this pleasing lustre very long, unless great care is taken to cover it with cotton or wool and place it in a close drawer, as it oxidizes rapidly and at length the acicular prisms themselves appear to vanish, leaving the limestone with the same columnar look, but coated only by a disagreeable rusty colored substance.

In the siliceous or cherty limestone of the falls of Niagara, there is an indication of the same appearance, but it is very indistinct, and has been taken, by casual observers, for petrified wood. See plate, fig. 1.

Kingston is, however, (as far as we have hitherto seen,) its chief locality, and as neither Jameson, Cleaveland, Phillips, nor any other mineralogical writer notices it,* I suppose it must be very uncommon, and perhaps a new substance. I have, unfortunately, neither the apparatus nor the leisure to have it properly analysed, and conjecture, with Mr. Baddeley, to whom I shewed it soon after his arrival at Kingston, that it may be only a sport of Nature, in modifying the shale which so abundantly accompanies the thin seams of the limestone of the Cataraqui. I fear the trivial examination appended in the subjoined note, will scarcely prove of much utility in affording a description of it, but it is ever better, I conceive, to afford all the facts concerning a mineral newly discovered, than to withhold any, merely because they are not sufficient.†

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* A specimen has been sent to Professor Thomson, at Edinburgh, (Glasgow?) who, I hear, says he has never before met with such a mineral, but supposes it to assume the appearance from organic remains, which I respectfully beg to differ with him about, as it seems to me altogether improbable.

† As this substance appears to me a very interesting one, I shall therefore give a slight notice of its mineralogical characteristics.

A small knob or cylindric column of lime, entirely embraced by it, being immersed in dilute nitric acid, was thus acted upon: a violent effervescence of the lime took place and lasted about five or six hours, moderating as it proceeded, until all action ceased. At first, flocculi of a tea leaf brown appearance, separated and swam on the surface; then small needle-shaped brown masses floated, and a great deposit of aluminous matter, of a dirty white brown color, subsided.

The shell or skeleton of the substance which had invested the lime was now left nearly perfect; its round cup-shaped bottom being very thick in proportion to its walls or sides. The outer face was scarcely altered, and even retained its shining hair brown lustre; the inner surface was of a dingy ashy hue.

On washing carefully with water, a more perfect separation of the fine thin wall took place, but by addition of acid no further effervescence or alteration occurred. It was then again washed and left all night in water, but no change was effected.

This curious substance appears to me, very decidedly, to be an infiltration, as the cup-shaped ends are invariably present, either as a whole or in part, and are uniformly thicker by many lines than the vertical portions, whilst the bottom of the cup is again thicker than its own sides, which also gradually thicken as they curve down.

In the denuded masses of the limestone it is much more easily extracted than in those which have not been long exposed to the action of the atmosphere, and the upper surface of the limestone has then

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The skeleton, after being left twelve hours, suffered no alteration. It was then put into a strong solution of prussiate of potassa, but no variation took place; the solution remaining colorless.

It was now removed into a glass mortar, with a small portion of water, and on slightly pressing it, it gave way and was with very little trouble pounded into a brown muddy mass, resembling clay. Upon this mud, the solution of prussiate of potassa was poured, when the usual indication of tritoxide of iron was observed.

When the precipitation had fully taken place, the solution was decanted and nitric acid poured over the precipitate, but no change nor any developement of lime took place until the prussiate of potassa was again admitted and the vessel slightly shaken, when the whole solution turned of a lively greenish blue, and in a few hours a copious dark blue precipitate occupied the bottom of the glass.

A little of the last nitric acid had been decanted off previously to the last experiment, but after it had remained for some hours at rest and muriate of soda was dropped into it, nothing occurred; the muriate subsiding in its proper form and remaining undisturbed.

In muriatic acid, both dilute and pure, the adhering limestone dissolved very slowly and with much less effervescence than in the nitric, but a copious deposit occupied the bottom of the vessel, which after twenty four hours was converted into a whitish jelly like substance, resembling borax when deprived of its water of crystallization. The mineral itself remained unchanged, although it required several fresh accessions of the acid to free it from its adhering lime and other foreign substances. After a few days standing, the borax-like clouds were gradually resolved into a browner white gelatinous mass, which sank to the bottom of the vessel. Taking up a portion of this substance accidentally, on a glass stirring rod, and holding it to the blue flame of a candle at the bottom, it bubbled violently, and communicating a vivid rose red light, (probably from the presence of the acid,) to the flame, it soon dried into a hard white coating on the glass, which required some trouble to remove.

For want of time and materials I could not continue the application of chemical tests, but at leisure intervals I subjected it to other analyses.

Before the blowpipe, on charcoal, there was no decrepitation; nor per se in forceps exposed; nor enclosed in the platinum forceps. With borax, on charcoal, it fused readily. With borax, on P. W. fusion easy; when cool, colorless glass. With salt of phosphorus, more difficult of fusion, but at length dissolved, and on cooling exhibited an opaline glass, with large flaws.

Its *specific gravity* is 2.5, or the same as the investing or invested limestone.

It has scarcely any action with the electrometer, although every precaution was used; its *electricity*, therefore, is feeble.

Magnetism, by the usual modes, shewed no action, or at least very feeble if any.

Phosphorescence—none apparent, in any way.

a yellowish white coating or crust, of some thickness. The columnar portion of the stone is also then well defined on the upper outside, like a chain of sutures or septæ, by faint brown lines which follow its contour, thus. See fig. 2.

The columns seldom terminate sharply or abruptly, but are rounded or bent, as already stated, over the top. See fig. 3.

Its resinous lustre together with its soft feel, would almost tempt an observer to say, that it was a bituminous coating merely, but trial proves otherwise ; it is probably a new variety of shale, in which there is a good deal of iron ; a good chemical examination will however, solve the difficulty. In the mean time, in order to afford all the information in my power, I make one more sketch of a beautiful little morceau, which is highly characterized by its graceful and deep flutings, the deepest fluting being at A, fig. 4.

It must be remembered, that the flat base is always actually the top of the columns, or in fact that all the figures, as well as the third, should be reversed.

When this essay was commenced, the writer believed that these beautiful specimens of nature's minute architecture were always perfectly vertical as regarded the bed of the layer of limestone in which they were inserted; but in taking a geological walk over Point Henry yesterday, he saw, in the more compact stratum already mentioned, proof to the contrary, as in one hard specimen alone were several columns variously inclined, and almost curved in another, which appeared to be imperfectly formed, and near which were large amorphous lumps of the same shaly matter. The difficulty of separating this particular species of the transition limestone had probably been the reason why these appearances had not been observed previously ; still however, whatever was the inclination, and it was generally very small, or whatever was the disposition of the columns, the fibres or prisms were always parallel to each other, and it is as well to mention now that this curious substance always shews two similar although distinct faces, namely, that of the face on the matrix or great body of the limestone, and that of the face on the limestone nucleus of the columnar body. The following is a sketch of the piece taken from the Falls of Niagara, in which it will be observed, the columnar appearance is coarser and less fluted, although it is perfectly distinct. The specimen is from the hard cherty rock full of siliceous particles which glitter in the sun like so many sparks, and is the more singular from being found in a rock so different from that of the transition limestone of the Cataraqui.

This specimen (fig. 5,) is of a grey color, and even the columns glitter with the siliceous particles of the cherty limestone of which it is composed. The prisms are broken, sharp, and not so soft or needle like as the Kingston ones; nor have they the bituminous or hair like appearance although their conformation is otherwise the same: I believe they are not common at the falls, never having seen any other specimen than this one from that locality.

Nature appears to have been in one of her most varying moods when the rocks and minerals of the neighborhood of the Cataraqui were formed, as in so small a littoral as that embraced by the waters of the Ontario and those of the Cataraqui and Gananoqui rivers, almost every variety of the primitive and transition classes with the confused detritus of ancient convulsions in the forms of boulders, sands, gravels and mud, are to be found without much difficulty. I have now before me, a mass of limestone glittering with calcareous spangles, in which is imbedded a large piece of basanite of the shape of the valve of a huge terebratula, but which, on closer examination, looks more as though it had been a flattened trilobite, and every day brings forth some new and equally curious variations from the usual appearances in similar geological associations.

But, although nature is so singularly sportive in her mineral creations on these hills, she appears to have been determined to withhold the evidence of the ages of the rocks as far as she possibly could in the remains of the animal kingdom. In a long and extensive course of quarrying, embracing nearly four years, only one perfect fossil was discovered and that the entomolithus paradoxicus, of which, from its comparative rarity in this locality, I cannot avoid giving the following drawing, figs. 6, (*a*,) and 6, (*b*.) The terebratular family are however, more numerous, some of the lower plateaux of the transition limestone being filled with their remains which are sometimes in a very perfect state; these, with a very limited number of the strange fossil of the orthoceratite tribe, named recently the Huronia, are the chief and indeed almost the only fossils which have been discovered here. In a future number of this essay, I hope to be able to depict a specimen of the tables mentioned in the first part, in which the Huronia reposes. The larger orthocerites hitherto discovered and of the pointed conical form are more numerous, but in general are in a very weather worn state. One or two I have recently seen which reached the great length of nearly five feet, and which I shall probably again revert to; but it is now time that we leave farther investigation of these fairy forms of architecture, and of animals left to our admiring eyes from the wrecks of ancient formations, to continue our tour, in which we stopped on the summit of Point Henry, and which, in proceeding eastward, brings us once more to the shores of Lake Ontario.

Directly opposite to the south west end of Cedar island on the main shore, a quarry was opened some years ago. This is called the soft limestone quarry, because the stone, when first exposed, cuts with much ease.

Amidst the wonderful variety of transition aggregates with which the singular locality we are describing abounds, this appears to be a mere bed or mass, and to rest upon the granite; but it is every where, as far as it is visible, surrounded by the usual dark transition limestone of the Cataraqui. It has been opened to some extent, and presents a continuous face for a considerable length, and at its base on one side, the hard layers appear as if conjoining with it, whilst here, on careful examination, may be seen the fact, that it also partially reposes on those beds, and that the passage of one into the other most probably takes place generally at this line of contact, notwithstanding instances occur where the soft stone appears, at it were, cemented to the dark blue limestone.

Near the junction of the two substances, a kind of variolous aspect is given to the soft stone by little sprigs or buttons of carbonate of lime of a dull white color, jutting from its surfaces.

This soft stone, so totally different from the other limestones of the Cataraqui, consists of silica, lime and alumina, and somewhat resembles, in its appearance and properties, the grés blanc of the French geologists, a building formed of it looking like those of the finest white freestone of Bath or Edinburgh. But, although it hardens a good deal by exposure, yet from the alumina being in quantity, it can neither resist the dripping of rain, nor the severe frosts and sudden thaws of the Canadian climate where it is exposed in thin portions. Its mean specific gravity is 2.6.

I believe that no fossil remains have been seen in this rock, which is regularly stratified and divided into bands or zones, assuming different colors as they become weathered. The two lower beds are of a lighter blue (approaching to grey,) than the hard rock on which they rest, and next to these, comes a band of an iron brown color, which, from the quantity of silica in its composition, disintegrates to a mere sand. This band is eaten outwardly into numerous holes in an almost continuous line along its centre, which have a very curious appearance, but proceed from the wasting away of a layer of amorphous crystals of carbonate of lime, which as they are generally either egg shaped or rounded exteriorly, may have proceeded from a deposite of testaceous remains.

Above the iron brown band is another much more inclining to white, which is again followed by a bed approaching to a bluish green, and upon that bed a thick brownish and very fissile layer is superimposed, which is capped by debris and soil from the hill above.

The hill now dips towards the lake, and the connection of this sandstone with the usual limestone of the locality is lost, and proceeding along the shores covered with numerous boulders of foreign rocks, we arrive, in a short transit, at a spot where the bank, again rising, shews more indications of the soft stone.

Here a struggle between lime and silica appears to have occurred, for the silicous particles have disappeared in a layer composed of calcareous tufa, which is visible for some feet, and being loosely coherent is easily extracted. It lies above the hard rock, and probably between it and the soft, which gives indications of terminating its course here. The specific gravity of this tufaceous bed is the same as that of the adjacent sandstone, 2.6.

The shores of the lake now become covered with boulders in which feldspar chiefly predominates, and from their size and number, they hinder the observer both in his progress and examinations. The limestone beds occasionally, however, present their bassets towards Haldimand cove, whereby may be traced the usual uniformity of their deposition, and it may not be uninteresting to the geologist to give an accurate section of those beds which have here been denuded in cutting for a well, and in which the almost regular alternation of layers of only a few inches in thickness at every third or fourth stratum of beds generally exceeding a foot, is very remarkable. Could these deposits have been regulated by the comparative absence or presence of the solvent, which in the ancient seas, caused the precipitation of the lime from the fluid, or were these regular formations of almost primitive matter, caused to vary in their quantum by being precipitated at long intervals, which is indeed the most probable, or how can we otherwise account for their regular stratification and the usual accompaniments of roughened surfaces which generally are coated with a thin white or black layer. The lower bed must in short, have been always hardened, before the upper one was laid on it. What long periods may therefore have elapsed in time whilst the transition limestone of the Cataraqui obtained its present magnitude.

6 ft.—soil and debris.	
10 in.	
2 ft.	
1 ft. 10 in.	
5 ft. 6 in.	This vast bed is extremely solid and hard, as indeed are all the rest, excepting two or three at the bottom, which are of a lighter color and softer; some near the top have a very thin layer of clayey earth interposed.
3 ft. $9\frac{3}{4}$ in.	
1 ft. 1 in.	All these strata appear to be nearly horizontal, at least, they follow the usual tendency of the Cataraqui limestone.
$8\frac{1}{2}$ in.	
1 ft. 7 in.	
1 ft.	
9 in.	
1 ft. $5\frac{1}{4}$ in.	
1 ft. 8 in.	
11 in.	
1 ft. $7\frac{3}{4}$ in.	
1 ft. $9\frac{3}{4}$ in.	
1 ft. $7\frac{1}{4}$ in.	
5 in.	
1 ft. 5 in.	

This section reaches to about two or three feet below the level of the lake. No appearance of shells or organic remains was observable in cutting it, and if it had been necessary to have carried it a little deeper, it would most probably have laid bare the subjacent granitic aggregate.

It is on the exposed surfaces of this rock, particularly on the low shores of the lake on the south side of Kingston, that we find those beautiful masses imbedded, which have excited so much enquiry and which were alluded to in a former number of this Journal.

They are composed of a mixture of barytes, strontian, crystallized carbonate of lime, iron pyrites and zinc; sometimes the first two ingredients alone are present; sometimes the mineral is apparently a component part of the rock, at others it is evidently a mere ball or mass enveloped by it and easily detached. Occasionally the carbonate of lime is slightly yellow or flesh colored, but the crystals, always large and without distinct form, are generally in curved layers and magnesian. Masses as large as a man's head have recently been discovered, and these, when broken, present some beautiful specimens, the blades or fibres shining with the lustre of new satin.

This substance was supposed, for a long time, to be tremolite, and certainly it bore the outward look of that species named after Lake Baikal, but its obvious specific gravity should have caused doubt; it was first described in the opening volume of the Transactions of the Quebec Society of Natural History, and from the specimen I used in analysing it, I had every reason to believe that it was a sulphate of barytes. Since that time a very attentive mineralogist, Mr. Baddeley, has given an account of it in this Journal, and pronounced it to be strontian. The question is however decided; both were right and both were wrong, and a conjecture hazarded in the interim has been verified by Professor Thomson, to whom the mineral was sent by the Secretary of the Montreal Natural History Society. It is stated by that eminent mineralogist to be a new substance, and he proposes to call it baryto-sulphate of strontian.* I am not, however, yet convinced but that many specimens of this substance contain pure sulphate of barytes only, in some of their portions, whilst others consist also of pure sulphate of strontian, although I am perfectly ready to admit that the masses generally are those of the new substance thus named.†

(To be continued.)

* According to the Professor's analysis, it contains eleven atoms of strontian and five of baryta.

† In a communication to Dr. Holmes, I had previously suggested that it might be a barytic sulphate of strontian, as I felt convinced that Mr. Baddeley's opinion as to the strontian was correct. With respectful deference to the Professor, I think *Kingstonite* would not be a bad name for it.

Art. IX.—*Notice*[*] *concerning the Garden of Fromont, translated for the American Journal of Science, from the Annales de l'Institute Horticole de Fromont, for April,* 1829; by Jacob Porter, M. D.

The Garden of Fromont contains a hundred and thirty arpents inclosed. Situated in the district of Ris, on the road from Fontainbleu, six leagues from Paris, it extends from the great road to the Seine and overlooks a large and fertile valley, which is watered by this river, in front of the forest of Sénart. The ground, for two thirds of its extent, descends rapidly to the north. All the upper part is good soil for grain, mellow and a little sandy. At a little depth is found the plastic clay, beneath which is a bed of sand or marly chalk, in which lie blocks of millstone. The lower part is good soil for rye, of little depth, resting on a bed of river sand, through which the waters of the Seine are infiltrated and rise when the river is high. This alternate and frequent motion of the subterranean waters supplies a little the dryness of the soil, and favors the growth of the large trees. Some small springs, fortunately situated in the upper part of the garden, are sufficient for the purposes of cultivation, and contribute to the beauty of the scenery. The park of Fromont, planted only twenty one years since, presents fine masses of trees and shrubs of every description. The scenery, in the interior, is simple and natural. The external views are rich and extensive; and, as the inclosures are seen from scarcely any point, the country appears to far greater advantage from the garden than the best drawings can represent it. One may observe very considerable masses of evergreens, of cedars of Lebanon in great numbers and very flourishing; and, on the downs, at the north, near the manor, is a very fine specimen of the true larch of Caramania, raised from seeds brought to France by the naturalist Olivier, who describes it in the third volume of his travels in the Ottoman empire, Egypt and Persia. This fine cone-bearing tree began to furnish seeds in 1826, by means of which it may be multiplied indefinitely.

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[*] Although this is a description of a local object, it contains many interesting and instructive facts and views which are of general application, and may suggest many useful hints to Americans.—*Ed.*

In the extensive heath grounds have been collected all the families of vegetables, that are designated in cultivation under the general name of heath plants. These grounds have been laid out for their protection, and, at the north, some large masses of trees are destined to serve for their shelter, and the surplus waters from the higher grounds are conveniently distributed by means of tubes, cocks, streamlets and gutters, moistening the ground, so to speak, drop by drop, and preserving it, almost without the aid of manual sprinkling, in a state of constant freshness. It is in this factitious soil, entirely formed by art, and whose surface is estimated at about three acres, that the magnolias, azaleas, andromedas, and the different rosaceous plants will hereafter flourish; indeed, they already afford a rich supply of seeds.

Such was Fromont less than six years since, when the proprietor, having obtained, in the vigor of life, that leisure, which the shepherd of Virgil regretted to have known so late, conceived the plan of making of a simple garden of pleasure a special monument consecrated to the studies of horticulture and botany; but he perceived that such an enterprise, in the hands of an individual, could not be sustained and prosper, except by its own products, and that it would fail essentially, unless industry should come in, with all its activity, to the aid of science, which might, in its turn, contribute to the prosperity of the former. An establishment of industry was therefore immediately founded, not as an end but a means, as the most solid and necessary basis of that edifice, the future elevation of which could not be determined, and the profitable cultivation of duplicates without number, is becoming the honorable means and the best guaranty of the indefinite extension of the scientific collections.

Greenhouses were constructed. Their arrangement is such that they present, in some measure, by their extent, their conveniences and their connection, the appearance of a hamlet, whose roofs are all glazed. Their length is about two thousand feet; and they present all the varieties of exposure, that renders them proper for every kind of culture. Water is brought into them by leaden pipes, and distributed by cocks, that pour it into some reservoirs in stone, in lead and in zinc, placed in each greenhouse, in such a manner that it may be made to flow in one of the divisions only or in all the divisions at once. In this way it may be readily made to suit the temperature of each greenhouse.

These different preparations are employed for the support and propagation of a collection of vegetables, (many of which are still rare in France,) which amounts already, including those in the open air, to more than six thousand species and varieties. The number of duplicates raised in pots is constantly kept at about a hundred and twenty thousand. The part of the garden devoted to heath plants is considered by the best judges as the most complete in the environs of Paris. To give an idea of the rapid increase in this department alone, it is sufficient to state that there were raised the last year, under glass frames, forty thousand of the broadleaved Kalmia, and that four thousand azaleas are arranged in pots for the grafting of more than a hundred and fifty varieties, according to the method of baron de Tschaudy. This kind of nursery is protected from the sun and the winds by the long palisades of Thurgas, and watered by numerous furrows; and at the same time that it is happily connected, by the prolonged contour of its evergreen mass, with the general scenery of the park, it includes within itself very considerable resources, of which the nurserymen and florists, both at home and abroad, who come hither to furnish themselves with assortments, know how to avail themselves.

At a time when the scarcity and dearness of wood are more and more sensibly felt; when some writings of distinguished excellence have been published on the necessity and the means of arresting this constantly increasing evil; when a benevolent individual has come forward to encourage by his writings, his example, and his patriotic liberality, the cultivation, on a large scale, of the best resinous trees; when a grand company embraces, in a single speculation, the clearing and planting of nearly two hundred thousand acres, it would be a lamentable void, in the establishment at Fromont, not to furnish the first elements of this grand forest plantation. But, far from incurring such a reproach, we have, on the contrary, brought forward the subject and treated it in a manner fruitful and novel, by calling the attention of our planters to the employment of precious elements, which, hitherto too generally unknown or undervalued, have never been introduced, as most certainly they might be, into the composition of our territorial riches. We wish to speak of those fine forest trees of North America, the oaks, walnuts, ashes, maples and pines, which our colleague, M. André Michaux, has described in a work, that ought to be in the hands of all planters; trees, whose various qualities might be brought under tribute in forming a good system of plantations and in the regeneration of our forests, as reason and observation, connected with elevated theories of physics and agriculture, already point out.

The summary ideas, that we have offered to the public on so important a subject, and that were at bottom nothing more than a corollary and application of the principles of cultivation and increase, are now, in some measure, brought forward and experimented upon in our own soil by some preparatory labors, the importance of which has been duly appreciated by enlightened persons, who have honored us with their visits, as well as by our correspondents. Innumerable seeds received from North America have begun to germinate in the soil of Fromont, and will permit observers to judge what great advantages, at the least expense and by repeated trials at different times as well as in different places, the mixture of the best forest species of America with our indigenous species would present in the primitive formation of large masses of wood. This inquiry is so important, the grounds, on which it would be interesting to make trials respecting it, are so extensive, the direction of the public mind in regard to plantations is becoming so decided, finally, the number of enlightened men, devoted and liberal, is so great in our beloved country, that, in order to favor and multiply experiments of this kind, our intention is to take as models, in this part of our labors, the grand nurseries of Scotland, which furnish to the kingdoms of Great Britain and the continent of the north the plants of forest trees in millions, at prices, that would seem comparatively trifling, and that persevering industry in their cultivation can alone explain; for it is in Great Britain and especially in Scotland that we must look for the finest and most useful examples of most horticultural establishments. And what interest have we but to do it? The bottom lands in France, whether belonging to individuals or the public, that are susceptible of being planted with wood, may be reckoned at millions of acres. It is, therefore, by millions that we must offer to proprietors and put into their hands, with instructions and conditions alike encouraging, the plants of all the trees, that are proper for adorning and making useful the places now wild and unproductive; sustained by public patronage the garden of Fromont will be able to effect this. We attach to this part of our enterprise an importance proportioned to its high utility, and we are so much the more encouraged in it, as we shall be guided by the talents and experience of our colleague, M. André Michaux, whose observations and works we shall often have occasion to cite. It is well known that it was not as a botanist merely that he studied the vegetables of North America, but that he applied himself to observe and describe their specific qualities and economical uses. With his name and his efforts are connected all the essays made in France and in Germany for the naturalizing in Europe of American trees. It is to him that the inhabitants of the United States themselves have begun to owe a more perfect knowledge of their own riches; and his benevolent cöoperation will be sufficient to recommend to public interest the exotic part of the forest establishment, that we propose to form.

But it is not enough to furnish proprietors with new sources of wealth and enjoyment; it is necessary that they should be taught how to use them. In an address delivered at the last public sitting of a society that has been obliged to suspend its useful labors, we attempted to show of what importance horticulture is to every one, and would be to us, such as has been conceived, brought forward and practiced before us, an enlightened and liberal nation, and what would be the advantages of its union with the kindred sciences, that is to say, of practice with observation, of labor with study, of intelligence with industry. Soon afterwards we had the happiness to see formed a Horticultural Society, similar to those of England. It shed around a sudden light; its utility was understood; the object of its labors was appreciated, and new ideas gave it favor. We are happy this day to connect our institution with such favorable circumstances, and to meet new wants, which are most sensibly felt. We will concur with all our power and all our devotedness to diffuse, for the benefit of proprietors, instruction among laborers; to inspire, for the benefit of laborers, the taste for cultivation among proprietors. This taste is the most natural to man, the best adapted to interest him; it is that, which connects itself most happily with serious ideas by what it has of reality, with virtuous pleasures by what it has delightful and pure. There is certainly no lack of materials for horticulture. Vegetable matter, in its application to the wants of man, is the theatre, on which are displayed two equally useful branches of industry, agriculture and horticulture. These two branches, so nearly related to each other, are enlightened, in their parallel progress, by a series of general ideas, equally applicable to both. But agriculture operates only on large masses; its labors are extended, but uniform as the plains it cultivates; and its meditations, serious and peaceful, still leave much leisure to our minds. Horticulture, on the contrary, upon a theatre less vast, occupies and charms us by the elements that it employs, the processes that it invents, the experiments that it undertakes, the success that it obtains. Its attractive studies are constantly animated and sustained by variety and interest; and when it has, like agriculture, loaded us with real blessings, its cheering pictures come once more to embellish our dreams, while the laborer fatigued finds only heavy slumbers on a glebe too often rebellious.

SOULANGE BODIN.

ART. X.—*Chemical Works.*

1. BRANDE'S MANUAL.—This valuable work, (especially in the improved edition of Prof. McNeven of New York,) is extensively known in this country. A new English edition, three volumes in two, with the latest revision of the author, is announced in the London Journals. It will of course embrace all the improvements and corrections in the science, and as it will doubtless be republished in this country, it will add to the means of information in chemical science already possessed by our students.

2. Dr. TURNER'S ELEMENTS; third American, from the second and latest English edition. The American editions of this excellent work, published by Mr. John Grigg of Philadelphia, under the vigilant and accurate revision of Dr. Franklin Bache, have made it familiar to the scientific public of this country. Dr. Bache has corrected such errors of typography or inadvertence as were observed in the English editions, and our students, therefore, possess a chemical work which, in the American editions, is not only the cheapest in the language,* but inferior to none in precision, accuracy, discrimination and just philosophical views. Dr. Turner's Elements are a medium between the larger and smaller works, and upon the scale which he has adopted, there is no better chemical book. Within the limits which he has prescribed to himself, it is impossible to present to the student a more judicious selection of facts, or more scientific deductions from them. We understand from a friend, who is now attending on Dr. Turner's courses in the London University, that he is very skilful in manipulation and extremely happy in his experiments. From so active and accomplished a teacher and

* Confining the remark to the most complete elementary books.

investigator, we may expect repeated editions of a work which, from its deserved popularity in Britain and in this country, must continue to be in regular demand and cannot be supplanted by any cotemporary performance. It interferes not with the works of the other British chemists: those of Dr. Thomson, Dr. Henry, Dr. Ure, Dr. Murray and Prof. Brande, being sufficiently different in design not to come in competition with Dr. Turner,* or, materially, with each other.

3. Prof. J. W. Webster's Manual, *on the basis of Brande.*—For a notice of this work, we refer to Vol. XI, p. 377, of this Journal. Since that, it has passed through a second edition, and its adoption in several American colleges and other seminaries, evinces that its merits, as a judicious and faithful compendium of the science, are justly appreciated.

4. Prof. Green's Elements, *on the basis of Turner.*—Upon this basis, Professor Green has ingrafted various additions and improvements, resulting especially from his personal observations abroad, and more particularly while in Paris, under the auspices of some of the most eminent men of that city.

5. Dr. Henry's Elements, 11th edition.—It was our intention to notice this latest and much improved edition, more than a year since, when a copy was received from the respected author; but cares and labors have intervened, and prevented the fulfilment of many purposes, as well as of this. The following notice from Dr. Brewster's Journal for July 1830, (Edinburgh,) is so much in unison with our own views, and we were so much gratified by the extract which it contains, that we with pleasure insert it entire.

"From this new edition of Dr. Henry's system of chemistry, we extract the following recommendation, which is addressed to the notice of learned Societies. 'The great laws of combination in definite and in multiple proportions, on which the Atomic Theory mainly rests, have, more especially, derived increased support from the accumulated mass of evidence. In too many instances, it must be acknowledged, we have not, even yet, attained all the precision that is desirable, as to the true proportions in which bodies combine. Nor can we arrive at this degree of certainty, until the relative weights

* Mr. Grigg's editions are in a neat and convenient form, and perhaps the great demand for the work in this country, will enable the respectable publisher to give his future editions in a style more attractive to the eye.

of some of the elementary gases have been determined, with the aid of the most refined instruments, and with the most elaborate and scrupulous correctness. It were to be wished, indeed, that this should be attempted under the auspices of some one of those learned societies, which have been instituted for the promotion of science; and that the investigation should be confided to a commission of its members, whose skill, experience, and fidelity, would be a pledge for the accuracy of the results. The precise admeasurement of an arc of the meridian was not more important to astronomical truth, than the exact determination of the specific gravities of the elementary gases is to chemical philosophy.'

"With the importance of the foregoing observation we concur; and should be proud if the chief philosophical institution of our Scottish metropolis would take the lead in putting into execution so desirable an object.

"In the preface, the author has alluded to the deep loss which the scientific world has sustained by the death of Sir Humphry Davy and Dr. Wollaston, in a joint eulogium upon these two distinguished philosophers, which is characterized no less by its just discrimination of their respective excellencies, than by its forcible eloquence: 'It is impossible,' says Dr. Henry, 'to direct our views to the future improvement of this wide field of science, without deeply lamenting the privation, which we have lately sustained, of two of its most successful cultivators, Sir Humphry Davy and Dr. Wollaston,—at a period of life, too, when it seemed reasonable to have expected, from each of them, a much longer continuance of his invaluable labors. To those high gifts of nature, which are the characteristics of genius, and which constitute its very essence, both those eminent men united an unwearied industry and zeal, and research, and habits of accurate reasoning, without which even the energies of genius are inadequate to the achievement of great scientific designs. With these excellencies, common to both, they were nevertheless distinguishable by marked intellectual peculiarities. Bold, ardent, and enthusiastic, Davy soared to greater heights; he commanded a wider horizon; and his keen vision penetrated to its utmost boundaries. His imagination, in the highest degree fertile and inventive, took a rapid and extensive range in pursuit of conjectural analogies, which he submitted to close and patient comparison with known facts, and tried by an appeal to ingenious and conclusive experiments. He was imbued with the spirit, and was a master in the practice, of the inductive logic; and he has left us some of the noblest examples of the efficacy of that great instrument of human reason in the discovery of truth. He applied it, not only to connect classes of facts of more limited extent and importance, but to develope great and comprehensive laws, which embrace phenomena, that are almost universal to the natural world. In explaining those laws, he cast upon them the illumination of his own clear and vivid conceptions;—he felt an intense admiration of the beauty, order, and harmony, which are conspicuous in the perfect CHEMISTRY OF NATURE;—and he expressed those feelings with a force of eloquence which could issue only from a mind of the highest powers, and of the finest sensibilities. With much less enthusiasm from temperament, Dr. Wollaston was endowed with bodily senses of extraordinary acuteness and accuracy, and with great general vigor of understanding. Trained in the discipline of the exact sciences, he had acquired a powerful command over his attention, and had habituated himself to the most rigid correctness, both of thought and of language. He was sufficiently provided with the resources of the mathematics, to be enabled to pursue, with success, profound enquiries in mechanical and optical philosophy, the results of which enabled him to unfold the causes of phenomena, not before understood, and to enrich the arts, connected with those sciences, by the invention of ingenious and valuable instruments. In CHEMISTRY, he was distinguished by the extreme nicety and delicacy of his observations; by the quickness and precision, with which he marked resemblances and discriminated differences; the sagacity with which he devised experiments, and anticipated their results; and the skill, with which he executed the analysis of fragments of new substances, often so minute as to be scarcely perceptible by ordinary eyes. He was remarkable, too, for the caution, with which he advanced from facts to general conclusions; a caution which, if it sometimes prevented him from reaching at once to the most sublime truths, yet rendered every step of his ascent a secure station, from which it was easy to rise to higher and more enlarged inductions. Thus these illustrious men, though differing essentially in their natural powers and acquired habits, and moving, independently of each other, in different paths, contributed to accomplish the same great ends—the evolving of new elements; the combining of matter into new forms; the increase of human happiness by the improvement of the arts of civilized life; and the establishment of general laws, that will serve to guide other philosophers onwards, through vast and unexplored regions of scientific discovery.'

"The foregoing interesting extracts from the new edition of Dr. Henry's chemistry are sufficient. To enter into an analysis of such a well known standard work as this, proceeding from the pen of one who ranks among the most eminent chemical philosophers of the day, would indeed be a superfluous task. We remember many years ago, in a very different chemical era to the present, when the first edition of this work appeared under the unpretending form of a duodecimo volume, intended as a manual for the experimental student. From this time, Dr. Henry has been an unremitting laborer in the field of science, and as his work in its successive editions has kept a regular pace with the advances of chemical knowledge, to which he has himself been so distinguished a contributor, the eleventh edition now appears before the public in a very enlarged and ample form, containing a store of information, the selection and arrangement of which cannot be too highly rated. In short, Dr. Henry is to be esteemed as an author, who has always been an industrious collector of facts, and an accurate reasoner; avoiding premature speculations, and strenuous for the rigid canons of inductive philosophy. For this reason, his volumes may be recommended as among the most useful and the safest which can be entrusted to the hands of the student."

At the moment that this sheet is passing through the press, we learn that Mr. Desilver, of Philadelphia, has just published an American edition of Dr. Henry's eleventh. He has conferred on the scientific public of this country an obligation, which we have no doubt will be fully appreciated.

6. Murray's Elements.—This excellent work, in two thick octavo volumes, was digested by the late Dr. John Murray from his large system in four volumes. It is impossible for one who was accustomed to listen to Dr. Murray's living eloquence, to look into his works, without seeing the image of his luminous, philosophical mind. In his lectures,* his scientific style flowed like a deep river, clear, powerful and serene. His Elements of chemistry are among the first of the philosophical treatises of this day and are particularly adapted to the diligent perusal of the student, who, having attended courses of experimental lectures, is prepared to follow a connected train of facts and reasoning, digested in a lucid and attractive form, and presenting many original philosophical views.

The present edition, the sixth, is ably sustained by Dr. Murray's son, in the spirit of his father, and all his pupils and other admirers will be happy to find his reputation in such good keeping.

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* See an obituary notice, Vol. II, p. 355, of this Journal.

7. Dr. Thomson on Heat and Light.—This is the first part of a series of volumes, (a substitute for his learned and elaborate system,) which this able author designs to publish for the use of the students of the University of Glasgow, of which he is Regius Professor of chemistry. As he has allowed himself a full octavo volume for these subjects, he has expatiated with correspondent fullness, and the work is a very valuable digest of the most important facts and opinions on topics which are inexhaustible. His researches have enabled him to introduce much new important matter, some of it from sources not usually explored, and he has enriched this volume with many valuable tables.

By some perhaps, the style will be regarded as occasionally less condensed than is usual in elementary treatises of science, but no thorough student of these subjects will wish the account of them to be shorter. We shall look with impatience for the succeeding volumes of this great work.

8. Aikins' Dictionary.—It is a matter of great surprise and regret, that only one edition, (and that more than twenty years ago,) has been published of a work of incomparable excellence, and which is still an invaluable book of reference. From long and intimate familiarity with this Dictionary, or rather Encyclopedia of chemistry, we have no hesitation in saying that it is surpassed by nothing with which we are acquainted in the English or French language, and a greater service could not be performed to chemistry and the connected subjects, than by giving a new edition in the spirit and manner of the first, with all the discoveries and improvements to the present time.

9. Ure's Dictionary.—A fourth edition of this work, with the author's revision, has just reached this country. We have not had time to examine it, but cannot doubt that an author of so much acumen, zeal and industry, has given this work all requisite additions and improvements. Originally, this dictionary was published by the late Mr. William Nicholson of London, and it was exceedingly valuable, especially as it appeared before Aikins' Dictionary. It has been modernized, and in a great measure rewritten, by Dr. Ure, and the American public have been made acquainted with it through the improved edition of Dr. Hare. It is a very useful work, and we trust that the fourth edition will be found free from some personalities, which we regret to have seen in former English editions.

Among the books of this class, we may mention the small dictionary translated from the French, by Mrs. Lincoln. To those who find it inconvenient to consult the larger dictionaries, that now mentioned will prove very advantageous; under correct definitions, concise notices of the leading facts of chemistry are given, in a comprehensive and attractive form.

10. Thenard's Chemistry.—This, the only recent and full system of chemistry of the French, is a substitute for Fourcroy's great work—the System of Chemical Knowledge, in 11 vols. 8vo—which although diffuse and verbose, was very complete up to the time when it was written, (nearly thirty years ago;) it was on the whole a learned, eloquent and interesting work, and was ably presented, in analysis, in the perspicuous and condensed synoptic tables by which it was accompanied. Thenard's work, in five full volumes octavo, is not surpassed in learned fullness and accuracy. The author's method has however caused him to divide the different members of the same subject, and to separate them into all the volumes, which makes it an inconvenient work for consultation. As the last edition is four years old, we trust that another must soon be forth-coming, and it will be welcomed by the scientific world.

11. { 1. Cours of Gay Lussac, } Paris.
{ 2. Cours of Laugier, }

M. Gay Lussac, in a note in the Annales de Chimie et de Physique, protests against the publication of his lectures without his consent, and disclaims any responsibility for their accuracy,* observing at the same time, that the Parisian booksellers have thus discovered a new species of industry. It appears however that the work was revised by one of his friends. It is in 3 vols. with plates.

That of Prof. Laugier is in four volumes, one of which contains plates, &c.; both works are very neatly printed. I have not seen any disclaimer by Prof. Laugier.

In both works there is necessarily much that is common to all able courses of chemical lectures; but we are not certain that either work is exactly what their celebrated authors would have made them. Still, the chemical student and the chemical teacher will find in them much that is interesting and instructive, and he would read them with the greater interest could he be sure that they present a fair specimen of the manner of these distinguished teachers. There are gentlemen in this country who have listened to them, and who, on this head, could give us information upon which we can rely. In a pretty extensive examination of these works (the latest on elementary chemistry that have issued from the French press,) we have not been able to

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* He even intimates that this account of them is not altogether accurate.

discover any material discrepancies between them and the numerous published memoirs and other writings of these eminent men.

12. Berzelius' System.—We mention this work merely to say that the translation published in Paris is denounced and disowned by the author, and we must wait patiently for a French or English translation which he will sanction as accurate. From such a source we are entitled to expect new treasures of information.

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In writing the foregoing brief notices we could have pointed out some errors, but where there is such prevailing excellence, this duty may well be left to the private communications of personal and scientific friends, and to the vigilance and sagacity of the authors in revising their future editions.

13. Dr. Hare's Compendium.—This work was written for the author's pupils, and is made the companion of his public lectures. It contains a luminous and comprehensive sketch of scientific chemistry, and one as full as was consistent with the limits which the author had prescribed to himself, after allowing sufficient room for a detailed account of many varieties of chemical apparatus and experiments, especially those which have been the result of Dr. Hare's own invention and ingenuity. Excellent wood cuts are given of most of these, and many of them have been exhibited and described in preceding Volume of this Journal. No man in this country has labored so much, and so successfully, for the improvement of practical chemistry, as Dr. Hare; and if we were to mention only his compound blowpipe, his eudiometers, and his galvanic instruments, this statement would be fully established. In a future edition of his able work, he will probably enlarge, somewhat, the elementary part, and digest some things into system, that are now inserted in appendix.

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The foregoing notices were begun, only with the intention of mentioning the improved edition of Dr. Henry's Chemistry, and of some other foreign works; but they have been extended, almost without design, and are now thrown out, as being perhaps capable of conveying some useful hints to young students of chemistry, who have not had an opportunity of consulting various authors, most of whose works are well known to professors and other teachers.

We have, however, no idea of giving a sketch of all the chemical authors of this age, although it might have been very agreeable to mention some other works, as those of Scheele, Bergmann, Lavoisier, Chaptal, Black, Davy, Dr. F. Bache's System for Medical Students and the Philosophy of Chemistry of the late Prof. Dana; besides various miscellaneous but valuable writings, as those of Parkes, Watson, Priestley, &c. Gray's Operative Chemist, Dr. Porter's improved edition, we mentioned in Vol. XIX, p. 362, of this Journal.

14. Elements of Chemistry, *in the order of the lectures given in Yale College.*—An explanatory notice of this work, (then nearly finished,) was given in No. 2 of Vol. XIX of this Journal. The work is now completed, and is comprised within two octavo volumes, averaging a little over 600 pages, besides an appendix of 48. The figures (chiefly those of Dr. Hare,) are given in the pages in wood cuts, except that there are three distinct plates to illustrate Dr. Hare's galvanic instruments.

The principal discoveries and doctrines are brought down to the present time, and there are also notices of American science and arts, with many miscellaneous facts.

The principal object of this work is to present to the chemical student a condensed digest of the subject, in such a form as to facilitate his progress; it contains also copious references to original authorities, many pharmaceutical processes and medical notices, and the necessary directions for the performance of experiments.

Although this work was designed and executed in accordance with the wishes of former classes in Yale College, and is made the companion of the experimental course there given, the students of that institution are left at liberty to use it or not as they choose, and it is easily adapted to any other course in which a different arrangement of the subject is pursued, and in which it may be found useful.

Art. XI.—*Art de se preserver de l'action de la Flamme, appliqué aux Pompiers, et à la conservation des personnes exposées aux Feu; avec une serié d'experiences faites en Italie, à Genève et à Paris; par* M. Le Chevalier Aldini.

The art of preserving from the action of flame, applied to firemen and persons exposed to fire; with a series of experiments made in Italy, Geneva and Paris; by the Ch. Aldini. *Analysis by* Prof. J. Griscom.

Having received from our correspondent at Paris a copy of the above named work, and also, through the obliging attention of Consul Barnet, a number of lithographic plates illustrative of the means employed by the Chevalier Aldini to guard the body against the attacks of heat and conflagration, we now present our readers with an analysis of the work and a description of the apparatus.*

This task affords us the more pleasure from the personal acquaintance which we enjoyed with the benevolent author, whose useful labors in another fertile field of discovery have been long known and appreciated by men of science; and who now, at the venerable age of seventy two, is actively engaged in the applications of science to objects of humanity.

From a brief notice of the inventions of the Chevalier Aldini, in a preceding number of the Journal,† our readers are aware that the preservation from flame, which has been the object of his pursuit, was sought for through the medium of a covering of wire gauze and asbestine cloth, alternately placed over those parts of the body which are exposed to the most intense action of the heat. In his introduction, the author justly intimates that notwithstanding the efforts which men have hitherto made in rendering assistance to the helpless in cases of conflagration, the great number of victims, among those who generously devote themselves to the relief of the sufferers, furnishes the strongest evidence of the necessity of some further means of alleviation and security.

"The celebrated Peter Franck, in his *Treatise on medical police*, complains that in cases of conflagration, governments have not sufficiently borne in mind that human life ought to be the first object of their solicitude. Firemen, says he, ought to be supplied with a covering at once light and thick, enveloping the body as completely as possible, so as to enable them to resist the action of the fire. Greater benefits might also be expected, if noble encouragements were offered to every one who should brave danger and save the life of a human being."

"The spirit of speculation has given rise to insurance companies against loss by fire. These have doubtless done much good, but they afford no guaranty against the loss of life. What compensation is it to the owner of a house, to be assured that his mansion will be

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* The author's consent to this republication was also received. This analysis was ready in October, and has been delayed in expectation of the arrival of the remainder of the prints from Paris; only a few hundreds were sent out and the number necessary for a full edition was ordered from Paris in July, but as no intelligence of them is received after waiting six or eight months, we have had the prints lithographed anew in Boston; this statement will account for the delay.—*Editor.*

† Vide Am. Jour. Vol. XVIII, p. 177.

rebuilt by the insurers, for the benefit of his heirs, after this same house shall have become his tomb!"

Humane societies have been formed in numerous places for the restoration of persons from drowning and suffocation, and premiums have been awarded to those who have in such cases adventured boldly in defence of life, but how much more complete would be the satisfaction, if to the means of recovery used on those occasions could be added a new and more effectual safeguard against death by fire. With this humane object in view, the author has declined any recourse to the privileges of a patent, but cherishes the hope that his expedients will be approved and adopted by all enlightened nations.

The corps of firemen in France, (sapeurs-pompiers,) by the military precision of its organization and discipline, has furnished a model for that of Milan, Naples, Florence, Bologna and Pavia. At Rome they preserve the ancient name of *Vigils*, given to this corps by Augustus, who in the year 759 of the foundation of Rome, not satisfied with the nocturnal triumvirs, whose principal duty from the time of the Republic had been to watch over conflagrations, created a cohort especially destined to arrest the ravages of fire.

It gives us much satisfaction to find, by the appendices to the volume, which contain several reports, from committees of learned societies, on the inventions of Chev. Aldini, as well as by direct information from our correspondents, that he has received flattering testimonials of approbation from various quarters; among which may be mentioned gold medals from the Society of Arts, Manufactures and Commerce of London, from the government of Milan, and from the court of Rome; and the Grand Duke of Tuscany, who has taken a particular interest in these discoveries, presented the author with a rich snuff box of gold, with his cipher set in brilliants. But the most substantial acknowledgment is from the Royal Institute of France, which decreed to him, on the 30th of May last, the Monthyon prize of eight thousand francs.

Our author divides his book into twelve chapters. These we shall take up *seriatim*, and give an abstract of all their most useful contents.

Chap. I. *is on the use of maille or mesh-work, of metallic gauze, and of substances which are non-conductors of electricity.*

The author cites various experiments demonstrative of that property of metallic gauze, discovered by Sir H. Davy, which causes it to resist the passage of heat and preserve from combustion the most inflammable substances in contact with it, on the side opposite to that of the heating source. This is the principle of safety in the Davy lamp, now so extensively used by miners. It is now, we believe, generally admitted by chemists, that the effect of metallic gauze is to be ascribed to the repulsion of the flame by the metal,* rather than to the conducting power of the latter. The flame is thus prevented from coming into contact with the wire. The author partakes of this opinion, and he has proved that a gauze of amianthus produces a similar effect on flame. This appears to be the only substance of which, without preparation, a tissue can be made suitable for resisting flame. It is true that cotton and linen cloth, well impregnated with certain saline solutions, are rendered almost incombustible. Sulphate of alumina, carbonate of magnesia, and other salts, have this property; but none, according to Gay-Lussac, are equal to phosphate of ammonia. When a cloth well prepared with this salt is exposed to the fire, the salt melts, the ammonia is volatilized, and the vitrified phosphoric acid forms around the tissue a varnish which defends it from combustion. The cloth becomes ignited, but preserves its form and remains simply carbonized.

Chap. II.—*On the art of preparing amianthus, and rendering it fit for spinning and weaving.*

No substance, artificially prepared, resists the action of heat so well as amianthus, a property conferred upon it by nature. The Romans made much use of this material, and appear to have been well acquainted with the means of preparing it, though Pliny and others consider it as very difficult to work. The author finds that it is only amianthus of a certain consistence that is fit for use. It is often very white and shining, but too fragile. It sometimes contains lumps, which cause the fibres to be too short for spinning.

When taken from the mine, it contains generally portions of earth or other foreign matters, which must be separated by putting it into large basins full of water, where it should be left several days, simply renewing the water from time to time as it becomes charged with earthy or other particles. Hot water is preferable to cold, and it is of advantage sometimes to boil it either in pure water or in the lye of ashes. The author has tried weak muriatic acid, and other chem-

* The metal in this case, but the gases which are evolved from flame, will, by striking against any substance, cause a repulsion of the flame.

ical processes, as well as the action of steam, upon considerable masses of it, in strong vessels; but the result has not corresponded with the expense of the process. He deems it better, therefore, after washing the amianthus, to loosen the fibres by rubbing or beating it with wooden mallets; or, if it be in compact masses, with iron hammers, and immersing it repeatedly, in order to separate the filaments and render them supple.

In spinning the prepared amianthus, the use of the distaff is found to be inconvenient, in consequence of the ends of the short fibres presenting themselves perpendicularly, and thus breaking the thread. The best method is to place the wool between two cards or pasteboards, with a weight upon the upper one, as is done in the case of silk, and the spinning becomes immediately safe and easy. Oil is to be excluded from the spinning of this mineral. The author's experience also induces him to reject entirely the combing and carding of the material, and also the practice which Ciampini had recommended more than a century ago, of introducing in the spinning one thread of flax with three or four of the amianthus. It is highly inexpedient thus to mingle a combustible substance with the texture of that which is meant to resist the fire.

It is not to be understood that a cloth of this substance is absolutely incombustible. Like all other mineral bodies, it will melt at a very high temperature, and either vitrify or undergo decomposition. Being composed in part of carbonates of lime and magnesia, their saline ingredients are decomposed at a temperature somewhat below ignition. Hence in a furnace or before the blow-pipe, or in the focus of a burning mirror, it undergoes a change of composition and a diminution of weight; but as a large fragment or cord of it is less easily affected by fire than a small one, M. Aldini finds that the best cloth is obtained by making the chain of a double thread, and the warp single. If the threads be too coarse the texture is not so good, and the cloth is too heavy. Portions of amianthus, which, on account either of the shortness of its fibres, or the impossibility of separating them completely from each other, will not answer for spinning, may be converted into pasteboard. Sometimes this refuse is mingled with a portion of good material, and made into paper. Pasteboard of this material, may in certain cases be substituted for the cloth, which is always more costly.

Amianthus destined for cards or pasteboard, must first be washed and prepared, as if for spinning, except that the filaments need not be separated. It is then to be pounded until it acquires a pasty consistence; then mixed with common size, and subjected to the usual process for making pasteboard. These sheets have sufficient consistence to admit of being smoothed without abrasion. It has been manufactured under the author's direction at Milan, Florence, Bologna, and other places in Italy, in sheets of about half a yard long and a foot wide.

Chap. III.—*New method of enabling firemen to preserve themselves from the violence of flame.*

The author adverts to the power of the human body of sustaining, by well known artificial expedients, extremes of temperature from that at which mercury congeals, to that of the burning valley of the Niger, and even, as in the case of Blagden, Fordyce and others, to a heated air, exceeding in temperature that of boiling water. But all these are vastly below the heat of flame. The only means of supporting, even for a short period, such burning and destructive heat, is a defence similar to that which the author proposes—the interposition between the exposed parts of the body and the burning source, a substance which is at once a slow conductor, and incombustible.

The finer the metallic gauze, that is, the smaller the wire, and the more numerous the meshes, the better will it repel the flame. The non-conducting substance must evidently be such as to resist violent agitations of the air, and whirlwinds of flame, and of course it must have strength and weight. Amianthus would be preferable to every thing else, if it could be every where easily procured, and the preparation of its cloth were less expensive.

To prove by a simple experiment the efficacy of metallic gauze, the author takes two tubes of this wire tissue, the one enchased within the other, but separated by a thin stratum of air. Its diameter is such as to admit a finger clothed with amianthus. He then exposes the finger fully to the flame of a lamp or candle for three or four minutes with impunity. This is a much greater heat than that to which firemen are generally exposed.

In whatever way the defensive armors are arranged for the protection of firemen, the author lays down the following as rules of practical importance.

1. That the firemen avoid carefully all contact of their bodies with substances that are rapid conductors of heat.

2. That the armor be so prepared as to present the fewest possible openings.

3. That it be as light as possible, consistent with a proper degree of solidity.

4. That the junctures be so free as to produce as little constraint as possible to the limbs.

5. As flame commonly ascends, the openings which are unavoidable should be made on the opposite side.

6. That the firemen govern their movements so as to present the least possible surface to the direct action of the flames.

Chap. IV.—*On the buckler of wire gauze destined to ward off flame.*

To overcome the impetuosity of the flames, a buckler should be provided of an elliptical form, and of fine gauze, that it may be very light. The longer axis of the ellipse may be one and a half yards, and the shorter two and a half feet. It should be swelled in the middle so as to spread or divert the flames, which prevents it from becoming too intensely heated, and from its thinness it cools in a few moments, and does not prevent the fireman from seeing objects through it. Its longer axis should be thicker in the middle, to give strength to the handle which must be well fastened to it, and to the cross-bars which form its frame. The wire work should have a little play on the frame to prevent its warping. A ring should be attached to the handle, through which the arm might occasionally slip so as to leave the hand at liberty. This buckler may be strengthened, if necessity requires it, by cross wires placed near each other. Besides those of large dimensions, smaller bucklers might be provided, which would serve to arrest the flames through windows or other openings, and to protect the fireman who carries the engine pipe into the most difficult places. The author insists on the importance of this method of defence.

To prevent the flames from rushing from one apartment to another, through doors or windows, a buckler, in the form of a parallellogram, may be made of double wire, with a small projection of a metallic plate at each corner, with an opening for a nail, by which it could be easily fastened against the issue of the flame.

A large sized buckler enables a fireman to ascend or descend a stair case in flames, even in his ordinary dress. In cases of this kind, the precaution should be used of carrying a sponge in the mouth. This, the author states, is an important application of the buckler.

In the country, where destruction by fire is often most fatal for want of the means of extinction, one or two of these bucklers kept always at hand, might prove of the greatest importance.

Chap. V.—*On the manner of handling ignited metals, and of walking over red hot plates of iron.*

It may happen that the floor of a room or chamber, although fire-proof, may become so heated as to render it impossible, without protection, to pass into it, or through it with safety. But by clothing the feet and head with the defensive materials, the Chevalier Aldini has enabled fire men to walk over a grate of iron bars heated to redness, and through the openings of which the flames were vigorously ascending from a fire beneath. They have walked in like manner leisurely over cast iron plates, so heated that some of them have cracked in several places.

If there should be a necessity of performing an operation requiring time, e. g. breaking a hole through a wall, in a situation where the floor was thus heated, he recommends a wooden stool with iron legs. The seat of the stool to be hollowed out on the top, covered first with amianthine pasteboard, then with a quantity of ashes, (which is a slow conductor of heat) then a covering of the pasteboard, and lastly, the whole seat covered with wire gauze, nailed or screwed to the wood. If the hands be covered with gloves of amianthus, and then again with a glove of the metallic gauze, or simply with a second glove like the first, there will be no difficulty, as has been amply proved, in handling red hot bars, extracting from burning coals and ignited rubbish, articles of value, and conveying them to places of safety.

Chap. VI.—*On the manner of defending the head, so that it may be exposed to the action of flames and smoke, without injury to respiration.*

The first experiments of the author in ascertaining how far life may be preserved when the head is enveloped in flame, were made upon pigeons, chickens, rabbits and other animals. They were placed in cages of iron wire, attached to long handles, and surrounded with metallic gauze, so as to keep the flames at a certain distance. The interior was furnished with prepared stuff, and openings left at top for communication with the atmosphere. The animals thus placed, were retained in the midst of flames a much longer time than firemen would have occasion to remain in the course of their duties, in extensive conflagrations.

Thus encouraged, the experiments were extended to men. An armor was prepared for the head, whose interior surface was a tissue of iron wire, with a double metallic gauze, which enveloped it; the front was closed only by the gauze. This armature descended to the shoulders, and rested upon them, so that the top of the head was not in contact with the metal, but was defended by it from external blows, and being of considerable strength, and supported entirely by the shoulders, this armature is at once a fire guard, and a preservative against external violence.

Thus equipped, firemen exposed their faces to the combined flames of twenty-four and even thirty-six candles, as well as to the flames of wood and straw, and held them in this position for more than two minutes, with but a slight increase of heat. So satisfactory were these trials, that several young persons who witnessed them, wished to make the experiment, and did so more than once.

The difficulty of conceiving how an air of this kind can be *breathed* with impunity, will be lessened by the reflection that the temperature within the mask is much lower than without; that by the agitation usual in flame the air is frequently renewed; that in the air which is mingled with a volume of flame, the oxygen is by no means exhausted; that in such cases it is not the want of oxygen so much as the presence of carbonic acid, that causes respiration to become difficult; and that this foul and heated air is continually ascending and giving place to fresh portions of pure air.

To guard against the effects of smoke, is another affair. The author cites various methods which have been proposed by others, viz. covering the face with a mask of sponge, except two openings closed by glasses for the eyes, keeping the sponge moist with water, with an alkaline solution, or with chlorine, as the case may require; covering the face with leather, to which is attached a tube three or four feet long, containing at its extremity a moistened sponge. These are good precautions against smoke alone, but when smoke and flame are actively combined, they are not sufficient, and it does not appear that the chevalier has been able to propose any thing more effectual. He justly observes, that the existence of much smoke is an evidence that the atmosphere is not freely admitted to the burning materials, and therefore it is often advisable that a passage should be opened to the air, even at the expense of greater combustion, for a fireman properly armed against the heat, might be less in danger from it than from suffocation by smoke, and better able to extend relief. It would be well for firemen to learn to be able to suspend their respiration for a considerable time. This, with the other precautions, would enable them to render more extensive aid in cases of difficulty and suffering.

Chap. VII.—*On the dress fit for passing through flame, and on the construction of different parts of the armor.*

In all cases where the fire is violent, and the exposure to it must be continued for some time, the body must be completely enveloped with the resisting materials, and even then the buckler should be also used. A complete armor is composed of a cap of double metallic gauze, a cuiras or breast plate, pantaloons, gloves of metallic cloth, and of stockings of amianthus, over which metallic boots can be drawn. The cap of metallic gauze, and the mask of amianthus, have been described. The cuiras is composed of a light iron frame, covered with metallic tissue, destined to protect the trunk from the action of the fire. It closes on one of its sides, and has but one sleeve of metallic tissue, which is furnished at the elbow with a piece of metallic gauze, to give freedom to the arm; on the other side it is open, so as to be promptly fixed, and it fastens with brass buttons. The other arm will be sufficiently defended by the buckler. The pantaloons are of strong metallic tissue, terminated above by a thin iron plate with a longitudinal slit, so that by means of buttons and button holes it can be adapted to the shape of the wearer. These pantaloons cover the cuiras at top, and below they enter the metallic boots. But these boots the inventor finally abandoned, not only on account of their heaviness, but because they did not enclose the feet with sufficient firmness. In their place he substituted buskins of double metallic tissue, with a sole made of a very thin plate of iron articulated, and large enough to enclose the foot.

There should be provided a number of these complete armors of different sizes.

It was an examination of ancient armor that led M. Aldini to this contrivance; and it has been his study to render it as light and as supple as possible, and he is well persuaded that in its present state it would not be found oppressive to any fireman. It is far lighter than the warlike armor of the ancients, who combated in their ponderous clothing in fields far less honorable than those where humanity is the motive, and the saving of human life, the prize.

To reduce this apparatus to the greatest possible simplicity, the author found that the cuiras and pantaloons of metallic tissue might be omitted, and a dress of prepared cloth substituted, consisting of a jacket and pantaloons combined, with a cloth girdle. They may be drawn on over the common clothes in a few moments.

The cloth of which this vestment is made, must be prepared by a previous soaking in some saline solution. Phosphate of ammonia is the best, but alum is cheaper, and answers very well. One immersion of the cloth in the solution is not enough. The solution should be saturated, by dissolving the powdered alum in warm water. But the author, finding that the alum crystallizes on the surface of the cloth and then easily rubs off, proposes a strong solution of carbonate of potash as a substitute. He admits that the potash must be saturated with carbonic acid, otherwise the causticity of the potash would destroy the cloth; but he does not advert to the fact that the intense heat to which the garment is to be exposed, might decompose the carbonate, and thus defeat the intended advantage. He finds that sulphate of iron, or of zinc, or other metallic oxides, will answer the purpose.

In case of urgent necessity, a solution of common salt would be very useful, and even if a garment should be sponged with this solution, it would have a decided tendency to preserve it from combustion.

If over this vestment of prepared saline cloth, a tunic of metallic tissue, and pantaloons of the same material, were worn, the defence would be very great, and combine safety with facility of motion. This kind of dress, the author thinks, would answer very well in common fires; but, in consulting the history of conflagrations, he is satisfied that in extensive and violent fires, the armor first proposed ought not to be dispensed with, and that the buckler and cuiras ought to be used.

Chap. VIII.—*On the means of saving persons and valuable objects, in buildings on fire.*

This chapter, after noticing the difficulty and danger that people are often in when their own or an adjacent dwelling takes fire, contains only a brief account of some of the mechanical contrivances that have been proposed to rescue them from their peril; such as pullies, rope ladders, sliding baskets, jumping out of windows on extended sheets or elastic cushions, forcing pumps for supplying fresh air to persons in danger of suffocation, &c.; but in none of these inventions is there any provision for enabling firemen to rush into the flames, and endure the heat with impunity long enough to accomplish the important object of rescue and deliverance to those who are unable to help themselves.

Chap. IX.—*A summary account of the principal experiments made in Italy with the armatures and other apparatus.*

These experiments were commenced in 1827. They were witnessed by a deputation of the municipality of the city of Milan; and agreeably to the *proces-verbal*, duly attested by the secretary, firemen were able to expose their hands, arms, feet, and even their faces, to a burning fire of wood, without any painful constraint upon respiration, or considerable augmentation of heat. The apparatus consisted of gloves, caps and boots, as before described.

In 1828 the experiments were extended, and in that year, both at Milan and Pavia, firemen walked through the flames and smoke leisurely, which in one case extended about eight yards long, rising to the height of two to three yards. A cage was placed in the middle of the flames, and taken away a minute after, without injury to the animals it contained.

The author states that his illustrious colleague, the chevalier Scarpa, examined his apparatus with great interest, and pointed out several modifications of which he thought it susceptible.

After these preparatives the chevalier Aldini exhibited, in the beginning of June, 1828, before the viceroy of Lombardy and the authorities of Milan, his experiments with the apparatus, upon a large scale in the barracks of St. Jerome, which had been assigned him for the purpose. The firemen in their own simple dress, each with a sponge in his mouth and defended by a buckler of double metallic net work, ascended and descended a very narrow staircase, about which a fire of straw had been kindled, many times without injury; others resisted for a long time fire and smoke in a close chamber; and some in the complete armor walked many times over a grate of hot iron two yards long, and a fireman carried on his back, a prepared basket containing a child whose head was covered with a cap made of amianthine pasteboard, through flames several yards in length, and to reduce the defensive dress to the greatest simplicity, he shewed that when the fireman was covered with a cloth dress of a single piece, with bootees, gloves, and cap of wire gauze, and a mask of amianthus, he could walk through the flames carrying the child, &c. without danger.

In the month of February, 1829, by the direction of the government, the experiments were repeated in the yard of the barracks of St. Gervais, where the spectators were arranged in several rows and two towers were erected two stories high, surrounded by heaps of inflamed materials consisting of faggots and straw. The firemen braved the danger with impunity. One man with the basket and child, against the advice of M. Aldini, rushed into a narrow place where the flames were raging eight yards high. The violence of the fire was such that he could not be seen, while a thick black smoke spread around, emitting a heat insupportable to the spectators. The man was so long invisible that serious doubts were entertained of his safe return; but he at length issued from the fiery gulf safe and sound, and proud of the danger which he had braved.

Some time afterwards a circular fire was made in a large meadow, into the flames and smoke of which firemen entered, two of whom passed many times backwards and forwards carrying their own children on their shoulders, and were followed by a third who wore a dress entirely of amianthus, then made for the first time at Bologna.

The grand duke of Tuscany who had attended some of the experiments at Milan, engaged the author, through his minister, Fossombroni, to prepare suitable apparatus for the instruction of the firemen of Florence, and on the 26th of May, 1829, the author exhibited in that city before the grand duke a series of experiments, which were repeated on the first of June before the first authorities of the city, civil and military, the members of the Academy des Georgophiles, and a large part of the corps diplomatique.

Three rows of wood in the form of an amphitheatre, were arranged so as to form two alleys twenty five fathoms in length. A large number of firemen, properly prepared, rushed through the flames, and some of them passed through the alleys of fire six times. One of them carried his own child, eight years of age, through the flames, another carried upon a crotchet covered with an incombustible varnish, a man upon a saddle made for the purpose, and whose face was covered with a mask of amianthus; the captain of the company and some others carried large bars of red hot iron, protected by the gloves, and others plunged their heads into the flames guarded either by the mask or cap. Several physicians who attended the experiments, observed that some of the experimenters experienced very little alteration of the pulse. The result of these trials "surpassed any expectation that could have been conceived of the execution of a project of so much apparent danger."

Chap. X.—*Application of the safeguards against fire to many of the arts.*

The author supposes that in several of the arts in which high heat is employed, some of the contrivances which have been described may be of use.

In *glass blowing* the melting pot is sometimes overturned or nearly so, and must be righted. The ovens are exposed to the same accident. If the head and hands of the workmen were protected by the prescribed covering, the damages alluded to might be repaired more promptly and effectually and with much less risk than they now are. The same remarks apply to a certain extent to *pottery.*

In *high furnaces, reverberatory furnaces, melting, moulding, &c.* —The workmen would often be saved from injury in these arts if their faces were protected from inflamed cinders, and their lower limbs from torrents of inflamed metal. But they have never thought of rendering their clothes incombustible or of handling red hot metal in the act of forging.

Architecture.—The immense utility of wire gauze in closing passages against flame without interrupting the circulation of air, the passage of gas, &c. will sooner or later be appreciated by architects. To devise a suitable protection against fire is surely no less important than to guard against thunder by lightning rods, and no less worthy of architectural skill.

Varnish making, paper coloring, magazines of inflammable materials, &c.

The progress of the flames, in cases of accident in these fabrics is often too rapid for external assistance. The metallic gauze and other armor if at hand, might be of essential service to life and property.

Art of the sculptor and stone cutter.—A mask of fine metallic gauze is precisely what is wanted to guard workman from the chips and fine dust which are so injurious to the eyes and lungs.

Medicine and surgery.—Cannot the organs of sight and respiration be protected by the means recommended in exposure to disease.

Precautions against insects in places infested by them.—The metallic gauze placed before windows and doors, while it freely admits air, would exclude insects, more effectually than the stuffs used for that purpose.

Amianthine paper and pasteboard.—The packers of cloth may avail themselves very usefully of the pasteboard as a substitute for the common pasteboard. This has been done in Italy with complete success. The consumption of a great quantity of pasteboard is thus done away with, and also of the disagreeable smell which it occasions.

With respect to the amianthine paper, made by the common process, the author says he has several sheets of it half a yard long and a foot wide, and that it would be decidedly the best thing for bank notes or paper money; and more particularly for public records, for if an indelible ink were applied to it, it would be exempt from all risk of accident by fire. Boxes made of several thicknesses of the paper or pasteboard, would effectually preserve their contents, however exposed to heat.

The author states that he has improved the Davy lamp, by enlarging the meshes of the gauze, and making some other alterations, (not clearly described) which render it a valuable substitute for common lanterns for farmers, hostlers, &c. Wire gauze is manufactured in almost every considerable town in Europe, but that is not the case with fabrics of amianthus. Nature, however, is liberal in this production, and suitable encouragement is only wanting to render its fabrics far more common and accessible. It is said that Charles V. had a manufactory of it near Ghent, and that he used a table cloth of it, and amused his guests by throwing it into the fire in order to cleanse it. In China, cloth is made of it, but the price is excessively high; for a piece of it half a yard square, was sold, during the last century, for nine hundred francs. In the time of Pliny, amianthus was as dear as pearls, but since that time the price has greatly diminished.

Chap. XI.—*On the advantages which the foregoing processes may be of to insurance companies against losses by fire.*

Marine insurances are of much longer standing than those against fire. It was not until 1714, that the English began to provide against these losses; but they soon found imitators on some parts of the continent. Italy appears to have been very slow in admitting these economical institutions. In 1819, they were encouraged in the Italian states of Austria by an imperial circular. A company was formed at Trieste in 1824, and another at Milan in 1825. The king of Sardinia followed this example, and a company was established at Turin in 1828.

The author proposes that insurance companies should extend their risks to personal security. By providing companies with a certain number of suits of the defensive armor, and offering high rewards to those who, by their courage and dexterity, should rescue human beings from the devouring element, they would usefully and honorably extend the sphere of their influence.

The remainder of this chapter is chiefly occupied with remarks upon the imperfect operation of insurance in Italy. In Bologna, a large store-house was burned three years ago, and great loss sustained for want of the means of unbarricading a door, through which a large portion of the goods might have been saved. A person equipped with the Aldini armor, would easily have accomplished this object.

Chap. XII.—*General considerations on the causes of fires, and the means of preventing the disasters which they produce.*

The atmosphere (says the author) may be heated so far as to kindle very combustible materials, and which in their turn set fire to other matters more abundant, which burn only at a higher temperature. The minister Sommer, at Koningsburg, made many experiments to demonstrate this fact, and to ascertain the various circumstances of it, and he proved that conflagrations may occur without either negligence or crime. Cloth, wool, cotton, hemp, &c., which have been charged with oil, will undergo spontaneous combustion. This fact has been long known. The chronicles of Villani inform us that a fire took place at Florence in 1344, from the spontaneous heat of some oiled cloth, which burned eighteen houses and shops. These facts deserve the attention of all who have charge of custom houses and other depots of merchandize.

It is well known that many coal mines inflame spontaneously. Certain kinds of coal have this property, and the maritime police of certain countries prohibit its transportation in ships.

Sulphurous turf (and there is much of it) is also the cause of spontaneous fire, and requires the same precautions as coal of the same quality. In both cases, it is the abundance of sulphuret of iron, and its decomposition by moisture, that produce the heat requisite for combustion. The fermentation of hay and straw may set fire to barns. If the mass be sufficiently moist, no circulation of air will prevent the effect.

As the art of building advances, the causes of destruction are more and more removed. Incombustible materials are more sought after. The superb dock ware-houses of England are almost entirely of cast iron. In private dwellings, means have been tried to render wood incombustible, or very slow of combustion and easily extinguished. These consist of some external cement or covering, or of a substance which penetrates the wood, without weakening it; but this art has not yet attained perfection.

It is doubtless impossible to prevent fires altogether. Pliny, in speaking of the ravages which fire had just occasioned in Nicomedia, proposed to Trajan to form an establishment of one hundred and fifty select and skilful men, to be charged with the special duty of extinguishing fires and assisting the sufferers: this is the first idea of the institution of firemen.

In general, the means of extinguishing fires are the more efficacious the sooner they are applied. Let every obstacle, therefore, which can retard the operations of firemen, and the arrival of their apparatus, be as far as possible removed. The eyes of magistrates should be particularly directed to this point.

How extensive soever a conflagration may become, the well directed courage of the firemen may prevent a mass of distress. Though a whole town should take fire, there will be quarters where assistance would not be useless; but the power of man, as well as his foresight, has its limits. When Franklin had found the secret of preserving buildings from the ravages of lightning, he acknowledged that he made no pretensions to the means of preventing the encroachments of another deluge, or of a universal conflagration. But notwithstanding this limitation of power, the world will not renounce the use either of lightning rods or of fire engines.

NOTES.

Note, referring to the Introduction.—The practice of burning the bodies of the Roman emperors, enveloped in sheets of asbestus, was not, according to the author, so common as Pliny insinuates. They were burned in an enclosure of refractory stone, without any extraordinary precaution to prevent the ashes of the wood from mingling with those of the body. Suetonius, and other historians that have described the funeral of Augustus, Trajan, Severus, and other emperors, make no mention of amianthus, though its use had been then long known, as is attested by Strabo, Dioscorides and others.

Clement XI. presented to the Vatican library a magnificent urn of marble, which contained a winding sheet of amianthus, enclosing ashes and a cranium. This fine relic was discovered outside the *Nevia* gate in 1702. It is the only one hitherto found in the tombs of persons of distinguished rank. The tissue of this cloth is rather close, and the threads very coarse. The urn signified that it contained the head of a king or an emperor. The piece of cloth is nine palms long and seven wide. M. Aldini has made some as large.

Note, after Chap. VI.—The report of Gay-Lussac on the experiments of M. Aldini, and the observations contained in the Acts of the Milan Institute, perfectly agree in relation to the respiration of the firemen while in the midst of the flames. The author having, before he left Italy, made a head covering, consisting of a piece of cloth and a cap of wire gauze, found that it rendered the respiration painful, and he afterwards followed the advice of his friend Scarpa, and left an empty space for air between the envelope and the head. It is essential that the air in contact with the flames should not enter the lungs, not only because it is deprived of oxygen, according to the observation of Gay-Lussac, but because the temperature is in equilibrium with that of the flames, and consequently at its maximum. But in the midst of these whirlwinds of flame, in appearance so threatening, the fireman introduces air which has not lost its oxygen, and whose heat is still far below that of the flames, and this serves for respiration. The buckler opens a wide space for the column of wholesome air which precedes the man, and lowers around him the temperature of the medium in which he is plunging. Respiration is really in danger, only when he remains motionless, which cannot continue more than a few moments, from the activity which the fireman must necessarily exert.

Note to Chap. VII.—In this note, the author states his belief that amianthus (which he is aware may in most places be too scarce and dear) is not indispensable to the preparation of good armor. Wool rendered difficult of combustion by a chemical preparation, may be used as a substitute. In this case, white stuff or blankets are preferable, as being worse conductors than stuff dyed by some conducting material. At Paris, the men equipped in dresses of prepared wool, resisted the fire as well as those in amianthus. It is possible that in time the metallic gauze may be dispensed with, but the author thinks that until some further discoveries are made, an external covering of this material will remain highly important in extensive fires. Its properties are unchangeable and well known. Prepared woollen stuffs have not been very long tried. In Italy they have been used for two years, without any sensible deterioration. They must be carefully preserved from moisture, which would cause the wool to rot, and the iron to rust.

It is important that the dress be made as much as possible of one piece, for the heat penetrates at every crevice. The form given in the plates is that which has been found best.

The Appendix contains four official *Reports* on the plans of the Chevalier Aldini, for the preservation of the body from flame.

The *first* is that of Professsor Maurice on the experiments made at Geneva. A summary of these experiments was given in our last volume, page 177. They were very similar to those performed in Italy, and already described in Chap. IX.

The *second* is a report made to the Academy of Sciences at Paris by Gay-Lussac. The experiments here detailed, were chiefly a repetition of those before described. One of the firemen carried a child eight years old in an osier basket covered exteriorly with a metallic tissue, while the child had only a mask of incombustible stuff. The spectators witnessed this experiment with fright, but the result was very satisfactory.

The reporter states that M. D'Arcet and himself had proved, by a great number of experiments, that whenever an oven sufficiently heated emits smoke or flame, the air within this oven is entirely deprived of oxygen. It is therefore certain, he adds, that in flame, even after it may have been extinguished by the wire gauze, there must be imminent danger of asphyxia; and that if no difficulty of breathing ensues, a purer air must find access to the men, and this he conceives may occur in several ways.

1. It is certain that the men have not their heads constantly in the flame, which we know moves with the gentlest current, and thus affords moments favorable for respiration.

2. Admitting that the men remain too long in the flames to breathe freely, we must then conceive that fresh air may rise between the two tissues not in contact, and thus supply the respiration. Besides, it is not difficult to hold one's breath thirty, sixty, or even more seconds, and though we do not think that the firemen resorted to this in passing along the hedges of flame, the short time requisite to walk ten yards renders it possible.

But although in the open air, or in a free space, respiration may be effected without danger, it is certainly to be feared that in a confined situation, filled with smoke, which it is so common to meet with at fires, it would not be possible to breathe freely, though protected by the armor. Would it not be advisable then to provide a portable reservoir of fresh air, or a flexible tube descending from the mouth to the floor, where the purest air is generally to be found. The reporter insists on this point, for nothing so much interferes with respiration as a dense smoke. It would be well for firemen to exercise themselves, like divers, in holding their breath.

Amianthus is found more abundantly, especially in Corsica, than it was formerly supposed; and since Madame Lena Perpenti of Como has succeeded in making various qualities of tissue, and even lace, of this material, it cannot be doubted that this mineral may be used for the various operations of spinning and weaving, but it must always bear too high a price to admit of extensive applications. Hence woollen cloth properly prepared is to be preferred, and when well impregnated with sal ammoniac and borax it does not take fire, and may even be calcined without communicating combustion, and is also a slow conductor of heat. In this latter respect it has even the advantage of amianthus, as has been shewn by M. Hourens. Therefore, in point of economy, of facility of preparation, of convenient use, of lightness, and of slower conducting power, wool is preferable to amianthus,—and its resistance to flame, though incomparably less than that of the mineral, is nevertheless great enough to answer as a substitute for the latter in almost all the circumstances of ordinary fires.

The cloth of amianthus or prepared wool will alone afford a sufficient guard in common cases; while the metallic gauze in extinguishing flame does not sufficiently intercept the heat. The latter also, by its rigidity, constrains the motions of the firemen, a serious inconvenience when we consider how essential it is for them to enjoy the full play of their limbs. The reporter therefore infers that woollen garments, sufficiently thick and close, and well impregnated with saline solutions, or preferably perhaps several lighter folds, one over another, of close stuff, to prevent the admission of air, would alone be sufficient, and that at farthest it would only be necessary, in particular circumstances, to add moveable pieces of metallic cloth, to guard those parts of the body which are the most exposed to the heat, preserving always the two coverings at a certain distance from each other; for a close contact renders the metallic tissue more injurious than useful.

The reporters speak highly of the use of the buckler, either with or without the dress of prepared stuffs—and also of the advantage of metallic grating or wire work, as a stoppage to flame in doors, windows, &c.

On the whole, they recommend in strong terms the means invented by the Chev. Aldini, to enable firemen to penetrate buildings on fire, to remove valuable materials, and to preserve the lives of those who are liable to perish in the most frightful torments.

The *third report* in the appendix is from a commission appointed by the Prefect of Police, consisting of *D'Arcet*, *Marc*, *Baron de Plazanet*, *Meyniel* and *Gualtier de Claubry*. The third named commissioner, Baron de Plazanet, colonel of the fire companies of Paris, devoted much attention to the experiments of M. Aldini.

The report speaks favorably of the lamp or lantern of metallic tissue, introduced by the author. It may be set down upon straw or hay, or be surrounded by it without danger. If a straw should penetrate the lantern and take fire within, it will not communicate the flame beyond the meshes. A moveable muff has been added, to guard the flame against a current of wind.

It would have been desirable in the opinion of the reporters, that an experiment had been made in a *close* room or building filled with fire and smoke, and they are not confident that without a reservoir of condensed air, or some additional artificial way, there would be any safety in remaining in such a situation.

The metallic envelope must remain at a distance from that of the amianthus. When the latter is once heated it becomes dangerous. A fireman's hand was considerably burnt by carrying a red hot iron, although he did not announce the accident.

The commissioners are of opinion that the apparatus ought to receive some modifications in order to render the use of it prompt, safe, and easy.

The metallic armor should be rendered more flexible, and the means of putting it on and off more easy.

Other needful changes are pointed out, which it is presumed that the well established and enlightened zeal of firemen will in due time effect, to the benefit of science in an object which interests in a high degree the happiness of men.

The report commends in strong terms the zeal and benevolence of the inventor, and recommends the special appropriation of a fund to the further perfection of the apparatus—and also a reward to the first fireman, who, equipped in the new dress, shall preserve persons or property from the imminent danger of a rapid conflagration.

A new experiment on the 3d of November was still more satisfactory, the firemen having acquired greater confidence in their safety.

The *fourth report*, also from Gaultier de Claubry, made to the Societé d'Encouragement pour l'Industrie Nationale, consists chiefly of a recapitulation of the facts and experiments, which have been before detailed.

An account of the firemen of Paris.

The city of Paris has been protected against fires only since 1696. In the reign of Louis XIV, thirteen engines were provided. In 1722 the king extended the number to thirty, and created the corps of (gardè-pompes,) engine keepers, which has been successively increased. In 1811 it received a military organization, and in 1821 the king decreed that this corps should constitute a part of the army.

The corps of firemen is composed of four companies of one hundred and fifty four men. It supplies thirty two posts in the city and thirteen theatres. Each post or station has one or more engines; and in a very short time a great number of men and engines can be collected, and a fire never extends its ravages beyond the house in which it takes. The walls remain entire with their wooden partition, and it is very rare that the death of a single person occurs. The corps is daily employed in working the engines, and in infantry and gymnastic exercises.

Experience has proved that when a fire takes place in a theatre, assistance arrives from without always too late. Such places are therefore furnished with engines, which are placed in cellars in such a manner that those who play them may be sheltered from danger during the fire. The water is drawn through a hose from a reservoir immediately beneath, which is filled by the city aqueducts. An ascending pipe passes through the vault of the cellar, and leads to the fire. This pipe has branches at different stories, through which, by simply opening the stopper, the water plays. At each of these stop cocks is a screw on which is fixed a hose (boyau,) fifty feet long, at the end of which is a lance. These are enclosed in a closet, in which is placed a bell rope corresponding with a closet below, so that if the fireman in the upper story wants water, he rings to the one below; the latter does the same, and so on in succession to the cellar. When the fire is over, a second ring warns the engineer that it is time to stop.

In each closet is an axe, a hand sponge, another sponge on the end of a long rod, and a long hook for cutting cords and pulling down inflamed parts.

Reservoirs are also constructed in the upper stories of the theatre, from which pipes descend to the different parts of the house. Hose which can be speedily adjusted to these pipes are kept in due order in the closets.

Explanation of the Plates and dimensions of the Apparatus.

PLATE I.

Fig. 1. The height of this apparatus is six inches. The lamp should be kept level so that the flame may not vary either in size or intensity. In bringing an iron wire about one tenth of an inch thick very near the flame it *goes out.*

Fig. 2. A wrapper of wire gauze and amianthus into which a finger is inserted and then held over a lamp, to shew the advantage of a glove for handling and carrying hot articles. The amianthus should be at least one tenth of an inch thick, and the two cylinders of wire gauze (the one inserted into the other,) must be of such dimensions that the fore finger may remain at ease in the enclosure. The exterior gauze may have sixteen wires to the inch and the interior thirty.

Fig. 3. A cup or saucer of porcelain, under which is placed a wire gauze, or a piece of amianthine cloth, to shew that the flame of alcohol is extinguished as soon as it approaches either of them, although the cup alone, at the same distance, does not produce this effect.

Fig. 4. This arrangement, destined to measure the action of the same flame at different distances, requires no particular description. In announcing the results, it is indispensable to note the size of the flame during the experiment.

Fig. 5. Wire gauze, of which the meshes are of different sizes. Parallel wires of different sizes, and more or less distant from each other, may thus be tried. By means of fig. 4, or other similar arrangement, their action on the flame is easily ascertained.

Fig. 6. Apparatus for determining, by means of the thermometer, the interior temperature of fig. 2, by varying the distance and volume of the flame.

Fig. 7. Cage of wire gauze, for conveying animals through flame. The bottom of this cage must have the form of a truncated pyramid, on which the animals must be placed, on wooden supports, rendered incombustible by chemical solutions.

Fig. 8. A stool, on which the firemen raise themselves for any special purpose. It should be of about sixteen inches diameter, and ought not to be less than four inches high. But it would be well to have them of different heights.

Fig. 9. Also for experiments on flame at different distances, and with different intervening obstacles. Its use will be manifest from the figure.

Fig. 10. A case of amianthus with its cover, of the same material. Its use is to enclose papers, or other objects to which its size may be adapted. In lieu of cylinders, boxes may be made of any desired shape. Pasteboard of amianthus answers well for this purpose. The tubes or boxes should be covered with wire gauze.

Fig. 11, 12, 13, 14, and 15. Various forms of the safety lanthorn for domestic, country or city use. That of *fig.* 12, with a double envelope of very fine copper gauze, may be safely taken into arsenals and powder magazines. *Fig.* 15, represents the firemen's lamp; and in *fig.* 16, is seen the arrangement of the holes of the circular plate of this lamp. The flame of it, is that of a wax candle enclosed in a tube, and kept up by a wire spring. Its envelope should have at least sixteen meshes per inch, or two hundred and fifty-six per square inch.

PLATE II.

The various parts of a complete armor for firemen, as they have been made in Paris, are represented in this plate.

Fig. 1. A helmet of wire gauze, known in commerce by No. 18. The head covering is of double, and the sight holes of single gauze. The dimensions ought to be such that the head of the wearer may not touch the helmet, especially at the upper part.

Fig. 2. Cuiras of metallic cloth. It should be so made that the helmet may be attached to it. It opens on the left, for the convenience of being put on easily. In order to close it, at Paris, they make use of clasps, and in Italy chains have been used. With the former, the wearer needs assistance in fastening it; with the latter he can fasten it himself.

Fig. 3. Pantaloons of metallic cloth, divided into two parts, which are fastened together by means of a clasp at the waistband. They descend to the feet.

Fig. 4, 5, 6. Boots of metallic cloth, with a sole of jointed iron plate. The upper part has also two covered joints, so that no burning material can get in, and the top of the boot behind is fastened by a chain to the pantaloons.

Fig. 7. Sole of amianthine pasteboatd, which may be replaced if necessary by other pasteboard of difficult combustion. These soles are adapted to the pantaloons, fig. 3.

Fig. 8. Jackets and pantaloons of cloth prepared for resisting fire. This dress should be very wide.

Fig. 9. Mask of amianthus, furnished with two wires covered with amianthus, to keep it at a certain distance from the face, and to permit the introduction of air for breathing.

Fig. 10. Head dress of amianthine pasteboard, covered with metallic gauze, for those whom the firemen may wish to carry through the flames. No opening is left for the eyes, but simply one for breathing, as it is better that the persons thus circumstanced should not see the danger which surrounds them.

Fig. 11. Glove of amianthus covered with a metallic gauze, supple enough to yield to the motion of the fingers. In fig. 12 this metallic gauze is replaced by a second glove of amianthus, including the first.

Fig. 13. A fireman in the prepared dress, with the boots of fig. 4 and gloves of fig. 11, walking on hot plates of iron and holding in his hand a bar of red hot iron. (Experiment in Italy.)

Fig. 14. Moistened sponge, with spectacle branches to keep it against the mouth. It is destined to retain matters injurious to respiration, in places filled with smoke.

PLATE III.

Fig. 1. Experiment in which the firemen, covered with the helmet and cuirass, expose their head to the flame of a hot fire, kindled in a vase whose capacity ought to be such that the volume of flame effectually envelops the head and its armor.

Fig. 2. Buckler of metallic gauze. It is fifty inches high and thirty inches wide. It may be made of two pieces, joined in the direction of the longer axis, with fastenings which will render it firm and compact when used. The wire gauze ought to be twenty to the inch. This buckler may be very solid without weighing more than 5 lbs.

Fig. 3. Grate of wire of the size of a door or window, to intercept the passage of flame through such an opening. The upper and lower rods are extended about four inches, and have a hole at each end, to admit of its being fastened with four nails. If a close double defense of this kind be used, it will be sufficient, in most cases, to extinguish flame and arrest the fire.

Fig. 4. Basket for removing children from the midst of flames. It is of wire gauze, lined with prepared woollen cloth. The cover is simply wire gauze.

Fig. 5. Crotchet for transporting men through flame. It is a wooden board, prepared for resisting fire. It should be about forty inches high and twelve wide. A kind of saddle, covered with prepared cloth, is attached to the middle of it, on which a man places himself. It is important that all its parts be firmly connected.

Fig. 6. This figure is designed to give an idea of one of the experiments made at Florence, in which a man carried by a fireman, and a child by another, walked for some minutes in the midst of the flames in a circular enclosure.

Art. XII.—*Geological Communications.*

1. *Crotalus? reliquus, or Arundo? crotaloides.*

TO PROF. SILLIMAN.

I send you the long promised drawing of the Montrose petrifaction. I have had it drawn twice, besides several other unsuccessful attempts. Our best connoisseurs in drawing agree, that it is very difficult to make a drawing of this specimen, which will convey a just idea of it. But Miss T. Lee, of the Troy Female Seminary, has succeeded in making the most perfect resemblance. I am anxious to have it laid before the scientific public, of both continents, for a decision on the question—to which of the two kingdoms of nature does it belong—the animal or vegetable? If to the animal, it is unquestionably of the order *ophidia*, and probably of the genus *Crotalus.* If a *Crotalus,* I give it the specific name *reliquus;* because I can deduce no safe characteristics from this fragment. It certainly bears some resemblance, in general outline, to the *Phytilus Martini*, which is of the reed family. But even the character of that petrifaction is not perfectly established. Besides, in my specimen, there are apparently essential differences. In the part marked F—curvilinear fibres, unquestionably the product of organization, appear as in the drawing; and there are traces of the same in the part marked D. It is true, that these may be the mineral substitutions for the veins of lateral leafy appendages; but it is truly wonderful, that a reed should present so many of the characteristics of the modern rattlesnake.

I presume naturalists will generally decide, that it is nearly related to Martin's petrifaction; therefore I will state particulars, to enable them to review the opinion given of *that* relic. The drawing here given is the natural size, and its dimensions are exact proportional measures. The curvilinear fibres appear strong and distinct—from one to three lines apart at their origin, generally converging towards their extremities, but in some cases distinctly bifurcate. It is the segment of a compressed hollow cylinder. On laying a rule from B to C, the depression in the middle is two lines.

This specimen was presented to me by Dr. Rose, of Montrose, in Susquehanna county, Penn. He found it in the graywacke rock, on his own estate. Mr. C. Van Rensselaer and myself, traced that rock to the Carbondale and Tioga coal deposits. It lies over the Carbondale anasphaltic coal, (commonly called anthracite, but I think improperly,) but we were not able to decide whether it *embraced*, *overlay*, or *lay under*, the bituminous coal of Tioga. The rock strata, embracing the Tioga coal and Carbondale coal, when traced into the state of New York, to the distance of thirty miles, are certainly separated by an extensive stratum of limestone. But the limestone may disappear, in a kind of cuneiform termination, a little north of the Pennsylvania line; leaving, what I have called, the second and third graywacke rocks to unite in one—the lower part embracing the anasphaltic, and the upper part the bituminous beds of coal. This specimen was taken from the rock in which reeds, ferns and palms are found in abundance. But if it is the remains of a vertebrated animal, all doubt ceases respecting the stratum, embracing the bituminous coal of Tioga, being upper secondary. If it is a culmiferous plant, the question is still open for discussion.

The graywacke rock, embracing the specimen, does not contain the glimmering scales, always found in first graywacke, and generally in small quantities in second graywacke. It is a dirty yellowish grey, in the cleavage where the impression is made; but of the usual color of graywacke, in a fresh fracture. AMOS EATON.

Rensselaer School, Troy, Jan. 22, 1831.

Since the above was in type, a note has been received from its author, saying that he had taken much pains to ascertain whether this species of petrifaction had been hitherto published or observed. Foreign journals were carefully examined, and enquiry was extensively made by a traveller in Europe. It appearing to be original and very interesting, was communicated for publication. A friendly call from J. H. Fielding, President of Madison College, Penn. has caused some doubt. He has an indistinct recollection of something of the kind, as he believes. The author therefore requests, that wherever this Journal is read, enquiry for a similar specimen, or a publication of it, may be sought and information communicated to the editor; as other parts of this organic relic may have been found, which will settle the question, whether it was an animal, or a vegetable of the reed family. One of our most accurate devotees to the study of recent organic relics, William Cooper, Esq. of the New York Lyceum, has examined it. He is in doubt, but is inclined to believe it an Arundo, or some plant of that family. Surely, says the author, it resembles the *Phytilus Martini*, when magnified with a power of 100.—EDITOR.

2. *The Gold of Mexico in a rock, equivalent to that which contains the Gold of the Carolinas; by* Prof. Amos Eaton.

At page 50, Vol. XVIII, of this Journal, I related facts intended to demonstrate, that the gold of the Carolinas was embraced in talcose slate rock; and that its gangue is quartz, of an intermediate character between the milky variety contained in argillite and the translucent variety of the granite. I have now before me more than one hundred specimens of the gold ore of Mexico, with its gangue and rock walls; both of which precisely resemble those of the Carolinas. These specimens, as well as numerous others of the silver, quicksilver, copper and zinc, of that country, were collected by George Robinson, Esq. of Curracoa, W. I. (whose son is a member of this school,) who has been engaged for twenty years in exchanging European goods for bars of Mexican gold, &c. In this collection are specimens from all the most important gold mines, extending north and south through a district of country of more than a thousand miles. I am authorized to say, that all these mines are contained, *chiefly*, in the talcose slate; and *wholly* so as a central range. By this expression I wish to be understood, that the mines sometimes extend laterally into the adjoining rocks, as the *hornblende rock*, *mica slate*, *&c.* but that the main body of every mine is in the talcose slate rock.

Rensselaer School, Troy, March 3, 1831.

3. *Scratches on elevated strata of horizontal graywacke in the Alleghany range; probably deluvial.* Communicated to Prof. Eaton, by Judge William A. Thompson,* of Sullivan county, N. Y.

Prof. Silliman.—The unpretending character of Judge Thompson, deprives the republic of science of much valuable information. He is the proprietor of Thompson town, is perfectly at leisure, and a nice observer. His estate lying in the most interesting part of the Alleghany range, gives him peculiar advantages. I have drawn from him the result of some of his geological observations.

Yours respectfully, Amos Eaton.

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* In a letter, dated Dec. 22d, 1830.

Extract from Judge Thompson's letter.

During my last visit at Troy, you strongly pressed me to communicate the result of some observations, through the medium of the American Journal of Science. My reason for hesitating on this subject is, that all my observations may have been anticipated. But at your request I will state, that for twenty years I have been forcibly struck with the following phenomena. Wherever the earth has been removed, leaving the horizontal graywacke bare, scratches and deep grooves are observed running a few degrees north of a due east course. I have observed this fact in more than fifty places, where the earth has been removed in the construction of turnpikes, common roads, mill works, &c. But they scarcely ever appear on rocks which have been exposed to air, rain, &c. When these scratches first attracted my attention, I was almost a stranger to the writings of geologists; but I could not resist the inference, that they were made by heavy rocks or boulders, driven over the surface of the upper layers of graywacke by the waters of the deluge. I was even inclined to infer, that the scratches indicated the direction of the oceanic waters. I did not venture on the opinion, that the waters moved in precisely the same direction in all places; but that here, in Sullivan county, such was their direction. I supposed that the *general* direction was every where the same; but that the particular configuration of mountains, valleys, &c. might give *local* variations to the course of the mighty movements of waters many miles in depth.

After ten or twelve years, I became acquainted with several geological works which gave the waters of the deluge a direction from north west to south east. I have only to say, that if these scratches indicate this direction, such could not have been their course here.

If these facts, which I should be pleased to point out to Prof. Silliman, or any other geologist travelling this way, (to whom I offer my house for a home,) should be thought worthy of any consideration, I may venture to present additional results of my observations, made in this place and its vicinity, during the last thirty years.

Respectfully your friend, William A. Thompson.

Amos Eaton, Esq.

ART. XIII.—*Abstract of Meteorological Observations, made by* Dr. S. P. HILDRETH, *at Marietta, (Ohio) in the year* 1830.—Latitude 39° 25′ N. Longitude 4° 28′—West of Washington City.

TIMES OF OBSERVATION, AT SUNRISE, AND AT 2 AND 9 O'CLOCK, P. M.

MONTHS.	THERMOMETER. Mean temperature.	Maximum.	Minimum.	Range.	Warmest day.	Coldest day.	Fair days.	Cloudy days.	RAIN. Inches.	Hundredths.	Prevailing Winds.	BAROMETER. Mean height.	Maximum.	Minimum.	Range.
												Inch. hund.			
January.	31.41	60	5	55	3	30	20	11	1	58	W.S.W. & N.N.W.	29.10	29.60	28.60	1.00
February.	34.25	64	0/4	68	20	3	21	7	1	63	W.S.W. & N.N.W.	28.97	29.70	28.50	1.20
March.	47.05	76	23	53	29	4	19	12	5	-	S.S.W. & N.N.W.	28.64	29.58	28.35	1.23
April.	58.52	86	30	56	7,21	3	27	3	1	-	S.S.W. & E.S.E.	28.91	29.51	28.48	1.03
May.	60.93	84	37	47	3,4	7	25	6	3	80	S.S.W. & N.	28.79	29.10	28.48	.62
June.	68.31	89	51	38	14	3	25	5	5	84	W.S.W. &N. N.W.	28.64	29.00	28.18	.82
July.	76.94	94	54	40	19,20	9	26	5	3	50	W.S.W. & N.	28.67	28.95	28.48	.47
August.	73.41	94	48	46	19,20	4	29	2	0	75	W.S.W. & N.N.W.	28.71	29.02	28.40	.62
September.	64.06	90	35	55	5,6	18	20	10	4	25	S.W. N.E. & S.E.	28.84	29.42	28.34	1.08
October.	58.77	80	34	46	27	4	24	7	1	91	S.S.W. & E. & S.E.	28.87	29.30	28.42	.88
November.	49.83	74	32	42	2	27	18	12	3	67	S.W. W. & N.N.E.	28.93	29.25	28.60	0.65
December.	35.74	60	0/5	65	3	22	8	23	4	33	W.S.W. & N. & E.	28.96	29.55	28.40	1.15
For the year.	54.93						262	103	37	26	*For the year.*	28.84			

Mean temperature for the year, 54° 93′, being, two and a half degrees more than in the year 1829.

Rain and snow, 37 $\frac{26}{100}$ inches, being more than two inches less than in the preceding year.

Prevailing winds, from the S. S. W. and N. N. W.

Heat the greatest in July, and least in January.

We have had fifty-three fair days more than in the year 1829; this will explain the diminution in the quantity of rain. The season, after the 4th of July, having been an uncommonly dry one—crops of Indian corn and potatoes suffering more from drought, than in any preceding year, since 1804: from the 4th of July to the 5th of September, there fell but two and a half inches of rain, while the heat from the 5th of July to the last of August, ranged from 85° to 94°, in the middle of the day, and the mean temperature for those two months was above 75° night and day. The heat and drought extended nearly or quite all over the Mississippi valley; while at the same time excessive rains were falling on the borders of the Green Mountains, and in the New England States. The spring months were unusually fine: fruit trees were in blossom nearly twenty days earlier than in 1829, and all the spring crops ripe two or three weeks sooner. Professor Olmsted's theory of our climate is by far the most plausible of any which I have seen, and his facts as to the prevalence of western winds over the United States, coincide with the observations made at this place. The general current of the atmosphere is from the west, setting round to the eastern quarter from the north, making a regular circuit in this manner, viz.—South-west, west, north-west, north, north-east, east, south-east and south; but never in the opposite direction. This series has been often observed in the vernal and autumnal months. The reader, in looking over the barometrical register, will doubtless be surprized at its low range. By comparing it with a table kept at Lexington, (Ky.) and one in Athens, (Ohio) I find it is too low by about $\frac{20}{100}$ of an inch, probably from there being a little air in the top of the tube. But from all the observations I have seen, there is a difference of nearly an inch in the mean annual altitude of the mercury here, or that near the Atlantic shore. I have kept a table of atmospheric variations for three years, but have offered none for publication until now; by making the allowance above noted, it will vary but little from the true state of the barometer in this part of the valley.

The winter thus far, up to the 15th of February, has been one of unexampled severity since the first settlement of the Ohio company, at Marietta, in the year 1788. The thermometer has been for a number of mornings at zero, and once or twice five degrees below, since the 22d of December last. The great snow storm, which seems to have visited the whole length of the United States, commenced here on Friday the 14th January, 1831, at 4 o'clock, P. M. and continued until Saturday, 11 o'clock, A. M. There fell fifteen inches in depth of snow, very level and even over the surface of the earth. A light breeze from the north attended the fall. The weather continued cloudy until Tuesday, with occasional light showers of snow.

February 15th, 1831.

Art. XIV.—*On a singular instance of Crystallization;* by Augustus A. Hayes.

At the extensive drug ware-house of Messrs. Henshaw & Co. of Boston, after a few weeks of unusually cold weather, a quantity of oil of sassafras was decanted from a canister which had contained a mixture of the oil and water; there remained at the bottom a solid mass, which was liquefied by heat, thrown into an open tub, and left uncovered, exposed to the temperature of about 40° Fah. twelve or fourteen hours. At this time it was observed that the whole interior of the tub, below the surface of the fluid, *was beautifully studded with large transparent crystals, closely resembling those deposited from a saturated saline solution.* The fluid was decanted and replaced by cold water from a well; covered with this, the crystals remained unaltered, an interesting object of curiosity to numerous observers, for several days.

Through the kindness of Mr. Henshaw, I was permitted to examine the forms of the crystals, and select from them a number, for the purpose of learning their composition, and observing the circumstances attending their production. The form was that of a hexagonal prism, terminated by low six-sided pyramids, variously modified; two lateral faces of the prism were sometimes so extended, that a line only marked the others; the faces of the pyramids were also unequal, and in a few instances, one plane obliterated all traces of the pyramid; often grouped, crossing each other at various angles, and then exhibiting both terminations; white, transparent, possessing a vitreous lustre, brittle, the fracture disclosing a regular internal arrangement; the odor, like that of the oil at the same temperature, was slightly fragrant. When detached from the sides of the vessel, they instantly subsided in the water. The temperature of the air being about 62° Fah., the crystals partially exposed above the water, were slowly diminishing in size and resuming a solid form, on those below, which were at 45° Fah.; the difference of temperature being maintained by the evaporation of the oil from the surface of the fluid, contained in an imperfectly conducting vessel. When withdrawn from the water, and wiped, they soon melted into a colorless fluid; in size, they varied from one and a half inches in length, by half an inch in width, to one-tenth these dimensions.

Having often observed the oil of sassafras, inclosed in glass phials, perfectly fluid, at all the intermediate degrees of temperature from —10° to +70° Fah., it seemed to me probable that a crystallizable compound had been produced by some alteration in the constituents of the oil. With this supposition in view, I carefully removed the adhering water from some fine crystals, by means of bibulous paper, and allowed them to melt in a clean, covered vessel. Portions of the resulting fluid, in suitable vessels, were cooled to different thermometric points, under circumstances deemed favorable to ordinary crystallization; the oil remained fluid, although its mobility diminished by reducing the temperature; yet no tendency to assume a solid form was indicated.

On examination, the fluid obtained from the crystals presented the physical and chemical properties of pure oil of sassafras, so far as I know them; precautions were taken to remove water if mixed with it, but the desiccating compounds were not moistened, nor could it be resolved into two fluids by distillation.

Recurring to the circumstances under which the crystals were first observed, a portion of the oil was placed, with three parts of water, in a cylindrical glass vessel, the vessel, immersed in a freezing mixture, was occasionally agitated, until the whole was reduced to a soft solid mass; crystals of the oil were now observed, and by allowing the vessel to remain in a warm room, the congealed water became fluid, leaving the crystals incrusting the sides and bottom of the vessel. The crystals thus obtained, presented varieties of the same form as the original crystals from which they were derived, and in relation to the quantity of the fluid, were quite as large in size. They remained thirty-six hours in an atmosphere, whose temperature was increasing from 46° to 58° Fah.; some fluid oil then collected in globules, and the exact temperature of a half fluid mass was 51½° F.

Roxbury Laboratory, 5th March, 1831.

Art. XV.—*On a change of Climate.**

(FROM THE WRITINGS OF THE LATE BISHOP HEBER.)

"The principal apprehension at present [in Norway] arises from the too rapid destruction of their forests, to the existence of which they attribute, with apparent reason, the superior mildness of their climate to countries under the same latitude."—*Life of Bishop Heber*, Vol. I. p. 80.

"The resemblance of the Tanais to the Nile has been remarked by many writers; but that these ample downs, whither its fertilizing waters cannot extend, have not since degenerated into a desert, like those of the Thebais, must be ascribed to the difference of latitude, and the beneficial effects of a *four months continued snow.*

"This rigor of climate is so greatly at variance with those interested reports which, in the hope of attracting settlers to her new dominion, were circulated by the empress Catharine; and it differs so widely from that temperature which might be supposed to exist in the latitude of forty-six, in the same parallel with Lyons and Geneva,—that though the ancients observed and recorded it, the fact has been very slowly admitted by the generality of modern inquirers. Even among those who yielded a respectful attention to the authority

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* Extract of a letter from David Thomas, Esq. to Prof. J. Griscom, dated,

"GREATFIELD, 12th Mo. 10, 1830.

"Since my last letter was written, I have read with much interest and satisfaction, some remarks of the late Bishop Heber on physical climate, which *differ in point of fact* from several writers on this subject. His opinion will command the greatest deference, not only on account of his eminent talents, but because he was on the spot to observe and to inquire. I copy such parts as appear pertinent to our present discussion.

"As much has been written *on a change of climate*, and, in my view, many erroneous notions widely diffused, perhaps it would subserve the interests of science, to offer Heber's remarks for a place in Prof. Silliman's Journal."

of poets and historians, many have been anxious to suppose that the peculiarity they describe, has long since ceased to exist; and they have deduced from this supposed difference between the ancient and modern climate of Scythia, a proof that by the destruction of forests, the draining of marshes, and the triumphant progress of agriculture, the temperature, not only of certain districts, but of the earth itself, has been improved.* But how far all or any of these changes may be able to produce effects so extensive, as it may reasonably admit of doubt, so it is in the present instance superfluous to inquire; since in Scythia these causes have never operated, and *no apparent melioration of the climate has taken place.* The country still continues, for the most part, in the wild state painted by Herodotus and Strabo; and all the countries bordering on the Euxine Sea are still subject to an annual severity of winter, of which (though in a far higher latitude,) the inhabitants of our own country can hardly form an idea.

"That water freezes when poured on the ground; that the ground in winter is muddy only where a fire is kindled; that copper kettles are burst by the freezing of their contents; that asses, being animals impatient of cold, are found here neither in a wild nor tame state,—are circumstances no less characteristic of modern Scythia, than of Scythia as described by Herodotus and Strabo.† Nor do I question the authority of the latter, when he assures us that the Bosphorus has been sometimes so firmly frozen, that there has been a beaten and miry high-way between Panticapæum and Phanagoria; or that one of the generals of Mithridates gained there, during the winter, a victory with his cavalry, where, the preceding summer, his fleet had been successful. In the neighborhood of the latter of these towns, by the Russians since called Tmutaracan, a Slavonic inscription has been discovered, which records the measurement of these straits over the ice, by command of the Russian prince Gleb, in the year 1068. But such events must, from the force of the current, have at all times, been of rare occurrence. By the best information which I could procure on the spot, though the straits are regularly so far blocked up by ice as to prevent navigation, there is generally a free passage for the stream unfrozen. Across the harbor of Phanagoria, however, sledges are driven with safety; and on the other side of the Crimea, a Russian officer assured me that he had driven over

* Howard's Theory of the Earth.

† Herod. Melpom. 28—Strabo, L. vii.

the estuary of the rivers Bog and Dnieper, from Otchakof to Kinburn. But not only straits and estuaries, but the whole sea of Azoph is annually frozen in November, [!] and is seldom navigable earlier than April. This sea is fished during winter, through holes cut with mattocks in the ice, with large nets, which are thrust by poles from one to the other; a method which has given rise to Strabo's exaggerated picture, of 'fish as large as dolphins, (apparently meaning the bieluga) dug out of the ice with spades.' This remarkable severity of climate on the northern shores of the Euxine, may induce us to give a proportionate faith to what the ancients assure us of its southern and eastern shores; and though Ovid may be supposed to have exaggerated the miseries of his banishment; and though religious as well as African prejudice may have swayed Tertullian in his dismal account of Pontus, it is certain that Strabo can be influenced by neither of these motives, where he accounts for Homer's ignorance of Paphlagonia, 'because this region was inaccessible through its severity of climate.'

"To account for this phenomenon, is far more difficult than to establish its existence; and the difficulty is greater, because none of those theories by which the problems of climate have been usually solved, will, in the present instance, apply. In elevation above the sea, which, when considerable, is an obvious and undoubted cause of cold, the downs of European Tartary do not exceed those of England. Forests, the removal of which has in many countries been supposed to diminish frost, have here never existed; and though the custom of burning the withered grass in spring, which has been for so many centuries the only secret of Scythian husbandry, may have produced in many parts of this vast pasture, a considerable deposit of saltpetre, it is not easy to suppose with Gibbon, that a cause like this can produce *such bitterness of wind*, or *such unvarying rigor of winter*. It may be observed, however, (and the observation, though it will not solve the difficulty, may perhaps direct our attention into the right train of inquiry) that it is only in comparison with the more western parts of Europe, that the climate of Scythia is a subject of surprise; and that in each of the two great continents, we discover in our progress eastward, along the same parallel of latitude, a sensible and uniform increase of cold. Vienna is colder than Paris; Astrachan than Vienna; the eastern districts of Asia are incomparably colder than Astrachan; and Choka, an island of the Pacific, in the same latitude with Astrachan or Paris, was found by the Russian circumnavigators in 1805, exposed to a winter even longer and more severe than is commonly felt at Archangel. In America, the same marked difference is observed between the climate of Nootka and Hudson's Bay; and even in so small a scale of Nature as that afforded by our island, the frosts are generally less severe in Lancashire than in the East Riding of Yorkshire. If then the southern districts of European Russia are exposed to a winter more severe than those of France or Germany, they may boast in their turn of more genial climate than the banks of the Ural and the Amur; while all are subject to a dispensation of nature which extends too far, and acts too uniformly to be ascribed to any local or temporary causes."—*Life of Bishop Heber*, Vol. I. p. 532—535.

Art. XVI.—*Fuel for Steam Boilers.*—Editor.

The vast consumption of wood in our steam-boats, and in some of our manufactories, must, in a few years, make serious inroads upon our forests, which (while the applications of steam will be constantly extending with our increasing population,) will, year by year, be wasted in a rapidly increasing proportion. In the maritime parts of the country, and especially in the eastern and middle States, this effect is already conspicuous in relation to the pine groves and forests, and especially those of the pitch pine. This fuel is decidedly preferred, because the resinous matter, with which it abounds, creates an abundant flame, that readily rolls along, in unceasing volumes, and thus applies the heat to the whole extent of the metal with whose surface the water is in contact.

In steam boilers, there must not only be a sufficient heat in the grate of the furnace, but the heat must be applied wherever the steam is to be generated. The fuel that affords the greatest abundance of inflammable gas is therefore the best. Flame is produced by the combustion of inflammable matter, in the state of gas or vapor; a burning substance which affords no volatile matter, cannot produce flame; thus iron gives bright sparks, but (if pure) no flame. Wood, in all its varieties, turf and bituminous coal, during their decomposition in the act of burning, emit vast quantities of inflammable gas and vapor, and therefore burn with abundant flame; but pure plumbago (black lead) affords little or no flame, and anthracite much less than the other varieties of fuel that have been named.

The vast mines of anthracite which exist in this country, (and of which accounts have been published in several of the volumes of this Journal) afford an inexhaustible resource for fuel, on the eastern side of the Alleghanies, while the bituminous coal is equally abundant on the west, and this variety of coal will hereafter be applied to the production of steam, when the forests of the Ohio and Mississippi, and their tributary waters, shall have been wasted.

It is well known, that the anthracite of Pennsylvania differs from that of the old continent, by producing considerable quantities of inflammable gas.* This is most copiously evolved when the coal is first ignited, and is gradually diminished in quantity, and finally ceases, with the continued action of the fire; and a very intense heat is long maintained in the furnace after the flame has nearly ceased. In this state, when the fire is in active ignition, if a little water is thrown upon it, the flame is renewed, and perhaps a great volume of it instantly bursts into the room. The cause is obvious; the water is decomposed by the highly ignited carbon, and its hydrogen being liberated, burns; this depends upon the well known chemical fact, that intensely heated carbon decomposes water, by attracting its oxygen; and by supplying a regulated flow of steam, passing in, beneath the grate, as much as the coal could decompose, without having its temperature too much depressed, (when it would cease to decompose the water, and the latter would operate to extinguish the fire) we might probably have a constant supply of flame from ignited anthracite. It is well known, that moistened anthracite burns better than dry; it will indeed not kindle so soon, but when kindled—which is most easily done by adding it to anthracite or charcoal, already on fire, it burns with very abundant flame. I have often observed that anthracite thrown into the fire with much snow adhering to it, burns all the better for this addition.† On putting a large mass of snow into an anthracite furnace, in a very active state, a great roaring was immediately produced, like that from a burning chimney, and the noise was rather startling, and continued till the snow was all melted and the water decomposed; by throwing in small snow balls in succession, the inflammable gas was produced in a more manageable way. It seems evident, therefore, that a supply of water, or of steam, duly

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* See Vol. X. p. 333, of this Journal.

† I do not advert to its use in the open grate, but in furnaces, such as are used for warming halls.

proportioned to the quantity and heat of the fuel, might be made to increase the activity of the fire, and to furnish it with an abundant flame. Water presents the great advantage of being without cost, and always at hand in the same apparatus to which the fire is applied.

It will be observed that we are not now speaking of a mode of increasing the quantity of heat, but of applying, advantageously, that which is produced. It would perhaps be unphilosophical to expect, that gas created at the expense of the fire, should do any thing more than to restore the heat which it had taken up when it became gas, and there could plainly be no increase of heat from this source, except from the oxygen employed in burning the inflammable gas, and which, mingling with it every where in the flue, might thus increase the quantity of heat evolved.

But there is another property of ignited anthracite, which it possesses in common with probably all ignited bodies. It decomposes various compound fluids, even where it does not operate by attracting oxygen; it dissolves the bond of union between the elements, and thus enables them, in new combinations, to assume the gaseous form.

This is the foundation of the important application proposed to be introduced by Mr. J. L. Sullivan, and described in an early part of the present number. He proposes to pass the vapor of spirits, and of inflammable oils, or other combustible fluids, through or over ignited anthracite, and thus to supply the only imperfection (in relation to steam boilers) of this admirable fuel. If no mechanical difficulty occurs in practice, it is not easy to foresee why a continued flame, sufficiently abundant to pervade the entire flue of a steam boiler, may not be thus afforded by ignited anthracite; the flame, by a due regulation of the supply of the inflammable fluid, or of its vapor, may be made more or less abundant, at pleasure; it may be very quickly stopped or renewed, by cutting off or opening the communication; the anthracite, remaining in the mean time ignited, there can be no loss of time in reanimating the fire, as happens when a fire of blazing pine is extinguished, and as the anthracite continues to burn for many hours with little variation of energy, the attendance of the firemen, instead of being constant, as now, (and distressing even to the spectator to behold, much more to these poor men to endure,) may admit of considerable intervals; taking care to supply the anthracite, once perhaps in half an hour, or possibly an hour, and in the mean time to regulate the flow of the inflammable vapor, which may be done without even approaching the mouth of the furnace.

If this projected improvement should prove successful, it would afford an additional and most important market for the coal of the anthracite mines, which perhaps, from its great abundance, and the increasing facilities of conveyance, may soon sink too low in price to enable the proprietors to prosecute their mining operations with fair advantage; nor is this all; it would afford also a new market for spirit, the cheaper kinds of which would then be used for fuel; they would be appropriated to the furnace instead of the firemen, and thus the great cause of temperance would be promoted by diminishing the temptation to drink, and an adequate substitute would be afforded for the consumption. Should there be found to be any advantage in mingling steam with the vapor of the inflammable fluids, it could be easily introduced by a very simple and obvious contrivance.

This proposed improvement appears therefore to be a fair and reasonable subject of experiment for the proprietors of steam-boats; and we are the more persuaded that it will be tried, as many of these gentlemen do not regard exclusively the profits of their capital, but view, with a benevolent and patriotic feeling, the great cause of public improvement and of national prosperity.*

Yale College, March 16, 1831.

Art. XVII.—*On the electro-magnetic properties of metalliferous veins in the mines of Cornwall;* by Robert Were Fox of Falmouth.—Communicated by Prof. J. Griscom.

Having received from my friend R. W. Fox of Falmouth, a copy of his interesting paper on the electro-magnetic properties of metalliferous veins, read before the Royal Society on the 10th of June, 1830, I have no doubt that the following abstract of it will be highly acceptable to the readers of the American Journal. The subject is new, and the author in his letter accompanying the paper, intimates the wish that analogous investigations might be prosecuted in this country. He expresses a desire in particular, to receive information relative to the prevalent horizontal direction and underlie of some of the principal metallic veins in the United States—the nature of their vein stones, and whether they accord with the rocks traversed; also, whether the metallic veins are intersected and shifted by other veins of quartz, clay, or other substances, as in Cornwall. In addition to

* We observe with pleasure, that coal (we suppose the bituminous of Nova Scotia) has been recently introduced into the Rhode Island steam boats, with much economy of room, money and trouble.

the information on these points which may be found in the pages of the American Journal, it is to be hoped that some of its readers may contribute something more specific, and accompany their statements with the result of experimental engineers, similar to those detailed in the following abstract. J. G.

The previous experimental researches of the author on the progressive increase of temperature in mines, suggested to him the opinion, that this internal heat, which he has so satisfactorily proved to be augmented with the depth, might be connected with electrical action. The fact of such an action his experiments have clearly established.

His apparatus consisted of small plates of sheet copper, which were fixed in contact with ore in the veins by copper nails, or pressed closely against it by wooden props, stretched across the "levels" or galleries. Between two of these plates at different stations, and a galvanometer, a communication was made by means of copper wire, one twentieth of an inch in diameter, which was at first coated with sealing wax; but this prevention was afterwards dispensed with. The galvanometer, used for detecting the electric action, consisted simply of a magnetic needle three and a quarter inches long, one eighth of an inch wide, and one twentieth of an inch thick. It was inclosed in a box four inches square and one inch in depth, having a a plated copper wire, one fiftieth of an inch in diameter, coiled round it twenty five times. No magnet was used to neutralize the terrestrial polarity. In some instances nearly three hundred fathoms of copper wire were employed.

The intensity of the electro-magnetic action differed greatly in different places; in some cases the deviation of the needle was inconsiderable, in others it went completely round the circle. In general it was greater, cæteris paribus, in proportion to the greater abundance of copper ore in the veins, and in some degree perhaps to the depth of the stations; and where there was little or no ore, there was little or no action. Hence it seems likely, that electro-magnetism may become useful to the practical miner in determining with some degree of probability, at least, the relative quantity of ore in veins, and the directions in which it most abounds. When the distance of the plates from each other in a horizontal direction was only a few fathoms, and the copper ore between them was plentiful, and uninterrupted by non-conducting substances, or the workings in the mine, no action occurred, owing no doubt to the good conducting power of the vein; but where a cross vein of quartz or clay happened to be between the plates under similar circumstances, the action was unusually great.

When the communication was established between two plates at different depths on the same vein, or between different veins, whether at the same level or otherwise, the electrical action was in general the most decisive. In fact, veins, which in some instances were almost destitute of ore, and did not affect the needle, per se, did so, though perhaps in a slight degree, when electrical communications were made between them.

The direction of the positive electricity was in some cases from east to west, and in others from west to east; and when parallel veins were compared, its general tendency was, the author thinks, from north to south, though in several instances it was the reverse. In veins having an underlie towards the north, the east was commonly positive with respect to the west; but in veins dipping towards the south, the contrary was observed, with one exception only, and that under rather unusual circumstances. In comparing the relative states of veins at different depths, the lower stations appeared to be negative to the upper; but exceptions sometimes occurred when a cross vein of quartz or clay intervened between the plates, and the higher one was on the negative side with respect to the horizontal currents.

In such cases it may be supposed that there is an accumulation of electricity in different states, on the opposite sides of the non-conducting vein. Such intersections of ore veins, and their being often very rich to a great depth in one direction and not in another, added to their varying underlie at different depths, which is not unfrequently reversed, may tend to produce apparent anomalies in experiments of this nature.

At Huel Jewel mine, the author obtained results between a heap of copper ore at the surface, and a plate fixed at different depths against the ore in the vein; the latter becoming negative, in proportion to the depth at which it was placed. Piles of copper ore at the surface did not act on the needle when tried together, independently of veins, nor was it to be anticipated that they would.

It is not improbable that the progressive increase of negative electricity observed in descending into mines, if hereafter confirmed, may be found to be connected with the progressive increase of temperature. The author has not discovered any distinct connection between the electricity and temperature at the same level, but then the differences of temperature are comparatively small. Nor does the electricity appear to be influenced by the presence of the workmen and candles, or by the explosion of gunpowder, although some veins of copper ore were blasted on different occasions in the immediate vicinity of the copper plates. At a very productive copper vein in Great St. George mine, the ground is so soft that gunpowder is not used: yet the needle was powerfully acted upon by the electricity it contained. On this occasion as well as on some others, the galvanometer remained at the surface, the wires being passed down through the shafts; and in this manner it was sometimes found that the electricity acted with considerable energy, so as even to cause the needle to revolve with some velocity.

In connection with the electricity of veins, the author deemed it desirable to ascertain the relative power of conducting galvanic electricity possessed by many of the metalliferous minerals; and it appeared to be in about the following order, viz.

Conductors.

Copper nickel, purple copper, yellow sulphuret of copper, vitreous copper, sulphuret of iron, arsenical pyrites, sulphuret of lead, arsenical cobalt, crystallized black oxide of manganese, tennantite, fahlerz.

Very imperfect conductors.

Sulphuret of molybdenum, sulphuret of tin, or rather bell-metal ore.

Non-conductors.

Sulphuret of silver, sulphuret of mercury, sulphuret of antimony, sulphuret of bismuth, cupriferous bismuth, realgar, sulphuret of manganese, sulphuret of zinc.

Mineral combinations of metals with oxygen and with acids.

Amongst the rocks prevalent in Cornwall, clay slate or "killas" seemed to possess the property of conducting common electricity, in a slight degree, but only in the direction of its cleavage, perhaps owing to the moisture it retained.

These facts are mentioned in some detail, because it is curious to observe that the conducting power of metallic ores appears to have no reference to any of the electrical or other properties of the metals in a pure state, or to the proportion of them in combination. Silver and mercury, for example, are combined with, comparatively, very small quantities of sulphur; and zinc, which seems to hold an opposite place to silver in the electrical scale, is also found in combination with a much less proportion of sulphur than is contained in copper pyrites, though the latter is one of the best mineral conductors of electricity. There are many other analogous examples, which prove that no conclusion can be drawn, à priori, from the nature or chemical arrangements of minerals, as to their relative electrical properties.

Much time and attention have been bestowed by geologists on the consideration of the origin and comparative ages of veins, and but little on the purposes for which they are designed.

The author thinks it will prove a vain attempt to reconcile a multitude of facts observable in mines with any known natural causes.

1st. The very oblique descent of a large proportion of the veins into the earth, in some cases in very hard rock, and in others in ground so soft, that it would immediately fall in, however small the excavation, without being completely supported by timber. Were it possible to conceive fissures to exist under such circumstances, it is not reasonable to suppose that they would not take the direction in which the resistance would be least, that is, either the vertical, or the line of the cleavage of the rocks.

2d. Veins are often divided into branches, which unite again at a considerable depth, including between them vast portions of rock, perfectly insulated by the ore or vein stones from the general mass; these, it is evident, could not have existed as fissures for a moment.

3d. Veins are continually subject to changes in their horizontal direction and underlie; their size also often varies exceedingly, one part being many times wider than another, without any reference to their relative position or depth under the surface.

4th. Although a portion of their vein stones are usually quite distinct in their characters from the rocks they traverse, they are generally, in part, of the same nature, and vary with the containing rocks, whether granite, elvan, killas, &c., and they are commonly too regularly arranged in the veins, and are found inclosing insulated portions of the ore, &c. in their very substance, to admit of the idea of their having been originally mere broken fragments of the inclosing rocks.

At Dolcoath mine, there is an instance of one ore vein intersecting another at different depths, and being itself intersected, and even shifted by the same vein at a greater depth.

Many other facts might, if it were necessary, be accumulated, relative to the position and intersection of veins, as well as the nature and arrangement of their contents, which are calculated to throw entire discredit on the various hypotheses which have been invented to account for their origin. But the object is rather to suggest whether the arrangement of veins, &c., does not argue design, and a probable connection with other phenomena of our globe.

Metalliferous veins, and those of quartz, &c., appear to be channels for the circulation of the subterraneous water and vapor; and the innumerable clay veins or "flucan courses," (as they are termed in Cornwall) which intersect them, and are often found contained in them, being generally impervious to water, prevent their draining the surface of the higher grounds as they otherwise would, and also facilitate the working of mines to a much greater depth than would be practicable without them.

With respect to their electrical properties, it may be observed, that ores which conduct electricity have generally, in this country at least, non-conducting substances interposed in the veins between the ores and the surface. Thus a brown iron ochre, with quartz, &c., named "gossan" by the miners, is almost invariably found resting on copper. Sulphuret of zinc occurs sometimes in the same situation, both with regard to copper and lead; but tin ore, which is a non-conductor, is without either, and is mostly found nearer the surface than copper.

Tin veins are usually intersected by those of copper when they do not coincide in their horizontal direction or underlie; thus, in this case, the conducting veins traverse the non-conducting ones. And when two veins of copper meet at opposite angles in descending, they are generally found to be unproductive at and near the place of junction; but when they unite, proceeding downward in the same direction, but at different angles, they are commonly observed to be enriched. These facts appear curious when regarded in connection with the opposite currents of electricity in veins having opposite dips.

Many of the phenomena of the mines bear striking analogies to common galvanic combinations, and the discovery of electricity in veins seems to complete the resemblance.

The author has been informed by intelligent persons, who have visited some of the mining districts of Mexico, Guatimala and Chili, that there is a general resemblance between the veins, elvan courses, &c. in some parts of those countries and our own; and he thinks it has been noticed by Baron Humboldt, that the stratification of primitive rocks in different and far distant parts of the world, has a general tendency from the north east towards the south west.

Such analogies become highly interesting when regarded in connection with terrestrial electricity, magnetism and heat; for if it be granted that the two latter increase in intensity at great depths in the earth, they are evidently so connected with electrical action that the augmentation of it also, in the interior of the globe, may be reasonably inferred.

However this may be, assuming that metalliferous veins exist more or less in primitive rocks generally, and experience favors this assumption, whether we refer to the new mines which have been discovered in various parts of North and South America, Siberia, Ireland, &c. or to the mining county of Cornwall, in which whole districts have comparatively of late been found abounding with mineral treasure, where none have been formerly supposed to exist, it may be presumed, that the electrical currents, which so affect the needle in the galvanometer, may likewise influence the direction of the magnetic needle on the surface of the earth; at least no explanation of this phenomenon appears to be so plausible or so well connected with ascertained facts. Even the cause of the variations of the needle, mysterious as it has hitherto appeared to be, may probably be referred to the relative energies of the opposing electrical currents, which are perhaps subject to occasional modifications; and the appearance of earthquakes and volcanic action, from time to time, seems to countenance the probability of such changes.

Nor should it be overlooked, in reference to this view of the subject, that the oblique bearing which is generally observable in the strata and veins, with respect to the equator, causes them, as it were, to cross at opposite sides of the globe, in the same parallels of latitude, so that their tendency, if any, must necessarily be to produce more than one magnetic pole in each hemisphere. Thus, in this respect also, the hypothesis accords with the interesting fact lately announced;—of Professor Hansteen having ascertained the existence of a second magnetic pole within the arctic circle. The revolution of the earth on its axis from west to east, seems to harmonize with the idea of oblique electrical currents; since rotation in the same direction may be produced by corresponding electro-magnetic arrrangements.

The author mentions the following facts in relation to increase of temperature in mines.

At Tingtang copper mine, in the parish of Gevennap, at the bottom of the shaft, at one hundred and seventy eight fathoms depth, the water was at the temperature of 82°. In 1820, when the same shaft was one hundred and five fathoms, the temperature was 68°; thus an increase of 14° has been observed in sinking seventy three fathoms.

At Huel Vor, the water was 69°, at one hundred and thirty nine fathoms, in 1819. It is now two hundred and nine fathoms deep, and the temperature is 79°.

At the bottom of Poldice copper mine, in 1820, at one hundred and forty four fathoms, it was 80°. Now, at one hundred and seventy six fathoms, it is 99°, and in a cross level, twenty fathoms farther north, the water is 100°. The two last are the highest temperatures observed in any of the mines of Cornwall. The water pumped up from this part of the mine was estimated at one million and eight hundred thousand gallons in twenty four hours.

Art. XVIII.—*Galvano-magnetism.*

The communication of Prof. Henry, in our last No., induced Prof. J. W. Webster of Harvard University, and Dr. Hare of the University of Pennsylvania, to repeat the experiments: their statements are annexed.

Dr. W. in a letter to the editor, dated Feb. 7th, 1831, says— Immediately on receiving the last No. of the American Journal, I set about constructing a magnet, and having procured a bar of twenty inches in length by two, arranged it in a frame. With five hundred feet of fine copper wire, and a single coil of copper and zinc, of three inches by two, it sustained all the weights I had at command. I then procured a beam capable of weighing six hundred pounds, the beam weighs twenty, and the armature ten; the whole was sustained. I am to lecture next week to the Mechanics' Institution in Boston, and shall use it in this state; after which, I intend to proceed to the maximum. I have no doubt it will carry twelve hundred pounds. May we not anticipate, that there will be some valuable application of this power in the mechanic arts? Every thing being adjusted, we have only to lift a tumbler of acid and water to the coil, and the effect is produced. I have also been constructing a new galvanic battery in two parts, each containing five hundred pairs of six inch plates; the effect I have as yet tried only with water and about a pound of salt; with this mixture, it fuses substances instantly, and gave the globules, which you consider, fused carbon.

In constructing the magnetic apparatus, there is considerable economy in using sealing wax instead of silk. I stretch my wires across the room, and with a spirit lamp heat each wire, following on with a stick of wax, which melts and covers the wire very equally; but I think the solution in alcohol preferable, as being less brittle and more readily applied.

Since the above was written, Dr. W. informs me that one hundred and twelve pounds were held suspended, during twenty one hours *after the coil had been removed from the acid,* and the plates had become perfectly dry.—*Ed.*

Prof. Hare, in a letter dated Feb. 24, writes—I have just made an apparatus, upon a small scale, in imitation of that of Prof. Henry of Albany, and it is quite successful. I used four coils of bell wire, of about fifteen feet each, wound first to the right, and then back over the coil first made, so as to bring the commencing and terminating wires to the same ends of the coils. All the commencing wires were soldered to one lead rod, and all the terminating wires to another, and these rods were severally made to communicate with the poles of a calorimotor, of about a square foot of zinc surface. I used no wrapping, but merely shell lac varnish, applied in winding, and paper between the coils. The magnet consists of an iron bar of three eighths of an inch diameter. It easily holds a fifty six pound weight, and would bear, I believe, a twenty eight in addition.

In another letter dated March 4th, Dr. Hare, in answer to enquiries which had been proposed to him as to his mode of construction, writes—that the wire was varnished by mixture of a thick solution of shell lac, in alcohol, and vermilion, the varnish being applied in the winding of the coils. This process was performed by a mandrill turned by a lathe, by means of a dog and centre points. The mandrill, a round iron bar of the same size and shape as the magnet, was wrapped in a coil of paper so as to thicken it. The coils were wound upon this for about two inches, one forward and one back, and between the first and second layer paper was interposed.

The coils thus formed, four in number, were slid upon the legs of the magnet, the poles of the wires pointing all in the direction of the bar or of the terminations of the horse shoe. It is of no importance how the wires are wound if put upon the bar in the order of their polarity, which may be ascertained by the needle. I first tried the magnet with four coils, two on each leg; afterwards, with six and eight, but found not only no proportionate increase but scarcely a perceptible one.

With four coils, my magnet, three fourths of an inch in diameter and about twenty inches long, held about ninety pounds.

The same coils on a shorter magnet of the same bar of about a foot in length held one hundred and twelve pounds.

The effect in charging other magnets seems to me the most important. A horse shoe magnet of about half an inch by thirty four, and about a foot in length from the beginning of one pole to the end of the other, following the curve, held three fourths of a pound. After twice drawing it over the poles of the artificial magnet in the usual way, it held four pounds. A needle of about a foot in length vibrated six times in two minutes; after treating it in the same manner as above described, it vibrated thirteen times in the same period. In each case it was held at right angles to the meridian and then allowed to vibrate.

Having made a magnet by tin foil coiled round the steel rod, I was led, in the multiplier, to substitute a strip of tin foil for the coil of wire covered by silk. A strip about one half of an inch in width and about seventeen feet long coiled up with paper intervening, is more sensitive than a coil of eighty feet of the covered wire. A single contact of bright plates of copper and zinc, one inch and a half in diameter, with moist paper interposed, causes a semi-revolution of the needle.

A third letter, dated March 17th, containing additional facts, has been received from Dr. Hare.

PHILADELPHIA, March 17th, 1831.

My dear Sir—Since I wrote to you last, respecting my multiplier made with tin foil, I have constructed another with a similar strip of that material of double the length (about thirty-four feet) resorted to in the first instance. The indications with a like degree of excitement are, in consequence of the additional length of the foil, more striking, and are decidedly superior to those obtained in an instrument made according to the European plan, with eighty feet of copper wire covered with silk.

It is well known that of two metals of different susceptibility of oxidizement, after contact with each other, that will be found positive, which is most oxidizable, and that negative, which is the least attractive of oxygen. In this sense copper is said to be negative in relation to zinc. It should however be recollected, that since the more oxidizable metal becomes positive by a discharge from the other, during the existence of a galvanic circuit, the metal which is negative in the sense above mentioned, forms the positive pole. Thus, if we constitute a circuit of zinc, moistened paper, and copper, the copper is positive; and if we connect it with the end of the coil which enters over the needle, and stand so as to look in that direction, the north pole moves to the left.

Having supplied the bottom of a saucer with a stratum of mercury from my pneumatic cistern, covered by water and paper, a disc of copper was placed over it on the paper. Under these circumstances I was surprized to find that when a wire proceeding from one pole of the multiplier, was held in contact with the copper, and the other wire dipped into the mercury, the same deflection took place as when a similar circuit was made, substituting zinc for mercury, the same wire being in both cases kept in contact with the copper. On substituting successively iron, tin, lead and tin plate, for the copper, the same wire being in contact with the mercury as in the first instance, I found this metal to have the same relation to all of them as zinc.

Its relation to zinc was found to be feebly of an opposite kind.

Subsequently, I procured an adequate quantity of pure mercury, by precipitating the protonitrate, by copper. This I found to have a polarity with copper and all the other metals above named, the opposite of that which the impure metal had with them. The impure metal had the same relation to it as zinc. Thus we have a convenient method of testing the purity of mercury, since a very slight impurity renders this metal *in the circuit* negative with copper, unless the impurity be of one of the precious or less oxidizable metals. Possibly we may in this way have the means of testing gold and silver, by amalgamation with mercury.

Having the keeper, and a weight of about fifty-six pounds, suspended by a galvanic magnet, of which the coils were in the circuit of a galvanic pair of about a square foot of surface, I attached one pole of my calorimotor, of fifty square feet, to the keeper, and the other to the vertex of the magnet. On completing the circuit of the calorimotor thus connected with the magnet, the weight fell off; I found, however, that although the power of the magnet was enfeebled, it was not destroyed, as in despite of the torrent from the calorimotor, it held, as nearly as I could judge, about half as much as before.

I have ascertained that when the poles of the galvanic magnet, while excited, are brought into contact with mercury, communicating with one pole of the calorimotor, above mentioned, the vertex of the magnet being in contact with the other pole, a gyratory or whirling motion may be observed in the mercury.

MISCELLANIES.

(DOMESTIC AND FOREIGN.)

1. Statistics of New York.—*(Communicated.)*—From the "*New York annual Register, for* 1831," a very useful statistical compilation, by Mr. Edwin Williams, we glean the following items of information respecting the State of New York.

Population—1,616,458 ; of which number 49,999 are blacks.

Yards of woollen, cotton and linen cloths manufactured in 1830, 14,466,226 ; number of grist mills, 2,264 ; saw mills, 5,195 ; oil mills, 121 ; fulling mills, 1,222 ; carding machines, 1,584 ; iron works, 170 ; trip-hammers, 164 ; distilleries, 1,129 ; asheries, 2,105.

There are 237 newspapers, publishing annually as is estimated, 14,536,000 printed sheets.

Manufactures.—There are 88 cotton manufactories, 208 woollen, 202 iron.

Cotton.—The cotton manufactories employ about 132,000 spindles. About 22,000 bales of raw cotton are used, and the annual value of cotton goods manufactured exceeds $3,000,000.

Wool.—Number of manufactories 208, exclusive of a "large number employed in custom work." Value of woollen goods annually manufactured, (exclusive of those made in families) considerably upwards of $3,000,000.

Iron.—Value of annual manufacture, $4,000,000.

Paper.—About 50 paper mills. Value of annual manufacture, $500,000.

Hats.—Value of annual manufacture, $3,000,000.

Boots and Shoes.—Val. ann. manufact.			5,000,000.
Leather.—	Do.	do.	2,905,750.
Window Glass.—	Do.	do.	200,000.

Manufactured in families, as per State census returns.

2,918,233 yards fulled cloth, value $2,918,233.

3,468,001 yards flannel, and other woollens, not fulled, value $693,600.

8,079,992 yards linen, cotton and other cloths, value $1,211,998.

The sales of domestic manufactures at the ware-houses in the city of New York during the past year, principally of wool, cotton and iron, are estimated to amount to *twenty-five millions of dollars,* exclusive of large amounts of articles made and sold by the mechanics of the city.

Agriculture.—Acres of land in the State, 29,494,720.

Acres of improved land,	7,160,967,	value	$179,024,175.
Neat cattle, . .	1,513,421,	"	15,134,210.
Horses, . . .	349,628,	"	17,481,400.
Sheep, . . .	3,496,539,	"	5,244,808.
Hogs, . . .	1,467,573,	"	4,403,719.
			$221,288,312.

Salt.—The amount inspected, and on which duties have been paid to the State the past year, is 1,430,000 bushels.

Canals.—Tolls for the year 1830, $1,056,799 67 cts., being an increase in the receipts of $243,662 22 cts. over those of the preceding year.

Banks.—There are fifty-two banks in the State, with an aggregate capital of $26,275,800.

Education.—Colleges, 4; medical colleges, 2; academies, 55; students in the colleges, including those in preparatory schools connected with Columbia and Geneva colleges, 506; students in the medical colleges, 276; students in the academies pursuing classical and other studies, 3,835; whole number of common school districts, 9,062; whole number of scholars taught in common schools, 499,424; increase of children taught last year, 19,383. From the report of the superintendant of common schools, it appears that the productive capital of the *school fund* now amounts to $1,696,743 66. The revenue received into the treasury on account of this fund the past year, has been $100,678 60. This revenue is less than one-tenth of the sum annually expended for common schools, viz.

Expenses of buildings for school houses, &c. per ann.	$115,694
Annual expense of books for 499,484 scholars, .	249,717
Fuel, ...	88,460
Amount of public money paid for teachers' wages, .	339,715
Amount paid by the different districts for teachers' wages, besides public money, ...	346,807
Estimating in the same ratio for 45 towns which have not returned the amount over and above public money, ...	21,308
	$1,061,699

Being a total of *one million sixty-one thousand six hundred and ninety-nine dollars* expended annually for the support of the common schools of the State. The superintendant's report to the legislature proceeds :—

"The preceding estimates show that the revenue of the school fund (that is, the amount derived from the State treasury) pays less than one-tenth of the annual expenditures for the support of the common schools; another tenth is raised by a tax upon the property of the towns respectively; and the two tenths thus made up, (being the $239,713 in the foregoing statement) constitutes what is called the school moneys, and is the sum raised by the commissioners of the towns for distribution among the several districts. Something less than two tenths, for school houses and fuel, is raised by a tax upon the property of the district, in pursuance of a vote of the inhabitants thereof; and the residue, nearly six tenths, or $617,820, is paid voluntarily by the parents and guardians of the scholars, for books, and for the balance of their school bills, after the public money has been applied.

"In fifty-two counties, the average number of those attending school, compared with the whole number of inhabitants, is as 1 to 3½. The average in the State, including New York and Albany, is in the proportion of 1 to 394-100. Appended to this statement, is a table, showing a similar comparison between the children at school and the whole number of inhabitants in various countries in Europe. In Russia there is 1 child at school for every 7 inhabitants; in Bavaria, 1 to 8; in England, 1 to 15.

"The children taught in the common schools of the State, fall only 576 short of half a million. According to an enumeration in 1829, there are 442 private schools in the city of New York; there are, at least, 40 schools in Albany, 27 in Utica, and numerous private schools in the other cities, and most of the villages of the State, the scholars of which are not embraced in the returns made to the superintendant. A complete census of the scholars in the colleges, academies and the private and common schools, would present a total of at least 550,000 scholars receiving instruction annually in the whole State, which is equal to 1 person attending school to $3\frac{1}{2}$ of the whole population, as ascertained by the late census."

Steam Boats.—There are seventy-five steam boats, (including six British boats plying on Lake Ontario) exclusive of steam ferry boats, &c., with an aggregate of 4,192 horse power.

Learned professions.—Of the clergy of the State there are *one thousand three hundred and eighty-two.*

Law.—The number of attorneys and Counsellors at law, is *one thousand seven hundred and forty-one.*

Medicine.—The number of practising physicians and surgeons is *two thousand five hundred and forty-nine.*

Military establishment.—The military force consists of *thirty-seven* DIVISIONS, subdivided into *eighty-one brigades*, three hundred and thirty-eight regiments, two separate squadrons of cavalry, *twenty-two* separate battalions of artillery and infantry.

The adjutant general's report returns the number of horse artillery at	1,716
Cavalry, ...	5,814
Artillery, ...	12,803
Infantry, including light infantry and riflemen, .	166,514
Twenty-seven companies of artillery and cavalry attached to infantry for inspection, . . .	1,679
Total rank and file, ...	188,526

The State owns 320 pieces of ordnance, of which 141 are iron, and 179 brass, with the requisite number of small arms, colors, musical instruments, tents and camp equipage.

2. *Fish of Hudson River.—Prof. Silliman.*—I have a neighbor on the bank of the Hudson, (within a dozen rods of whom I have resided ten years,) who has been most efficiently engaged in the fishing business, in the same place, sixty four years. To prove his efficiency in this business I may state, that he has accumulated a large estate in lands, houses in town, and bank stock, by this busi-

ness solely; without the least advancement by speculation. His account of the fish in this river, may aid the naturalist more or less; and he may rely upon Mr. A. as one of those who have the most scrupulous regard for truth.—Mr. A.'s statement.

Sixty years ago, the sturgeon, (*Acipencer sturio,*) and the common herring, (*Clupea pseudo-haringus,*) were the principal fish which came up as high as this place, (one hundred and fifty seven miles north of New York Bay, and one hundred and seventy seven from the Atlantic ocean.) Here the lock and dam were built between six and seven years ago, to improve the navigation. As the rapid was always an obstruction to sloops, when the water was low; it may be considered as the natural head of navigation. But boats could run up thirty three miles higher, to Fort Miller Fall. After passing that fall, boats could ascend to the Great Fall at Fort Edward, called Baker's Fall, ten miles higher.

Mr. Adams says, that herring fishery was worth but little when he commenced fishing; because they were so plenty, that in many places, particularly along the shores and in the little creeks above Still-water, farmers could drive their waggons into shoal water, and fill them in a short time, with a common scoop-net. But almost immediately after Gen. Schuyler erected a dam across the Saratoga Creek, about fifty six years ago, the herring began to diminish, and have continued to diminish yearly. Mr. A. supposed that their grand deposit for spawn, up the Saratoga Creek, was then broken up.

Sturgeons were in great abundance here half a century ago. I saw forty eight lie on the shore two years ago, at one time, (the shortest five feet, the longest nine feet,) which were caught in the space of three hours; and Mr. A. told me, that this would have been considered but an ordinary case, even thirty years ago, and that they had been diminishing yearly, for more than fifty years.

Bass (*Perca labrax*) were much more plenty half a century ago, than now; and pike were not uncommon, though now very rare.

It appears then, that herring, sturgeon and bass, have greatly diminished; and he says, that suckers, chubs, eels, sun-fish, and other fresh water fish, have neither increased nor diminished, materially.

The principal object of this article remains. It is the history of the shad, (*Clupea sapidissima.*) This fish is from thirteen to nineteen inches long, and weighs, before dressing, on an average, about five pounds. Seventy will generally fill a barrel, when dressed. When fresh, it is of a most delicious flavor; when pickled, it is not better than the common mackerel. Sells here, while fresh, for about ten cents—along the river, at a distance from cities and populous villages, for six cents.

From fifty to sixty years ago, Mr. Adams rarely caught over five hundred shad in a season; which was then confined to the month of May. Some seasons he caught but one hundred, with the utmost diligence. Before the dam was erected, shad increased quite as fast as herring or sturgeon decreased; and the season for taking shad increased to two months—beginning the latter part of April and continuing towards the end of June. The same diligence and the same method of operating, which gave him, at most, but nine or ten hundred shad, in the years 1789, 1790, 1791, &c. gave him about twenty thousand from the years 1820 to 1825. This gives an average ratio of increase, equal to more than the whole he ever caught in the years 1770, '71, '72, &c. He says, there has not been the same increase at all the fishing grounds between this place and the mouth of the river. But there has been more than a tenfold increase throughout the whole length of the river. Since this dam was erected, the number of shad has been gradually diminishing. He supposes the shad are reduced about one fourth, during the last five years. This he ascribes to the exclusion of the shad from their usual spawning ground, by the dam at this place; as very few are seen above the dam, even at Baker's Falls, formerly the best fishing ground on the river.

Queries respecting the increase of shad, on the Hudson River.

1. Does the increased population cause an increased wash of animal matter into the Hudson, which serves as food for shad?

2. Does the diminution of herring and sturgeon, cause the increase of shad?

3. Has a change taken place at the bottom of the Atlantic, near the mouth of the Hudson, which turned the course of shad into this river?

4. Does the increased number of fishermen, and the increased number of improved fishing grounds, by which twenty or thirty fold more are taken, kill off the older fish, leaving room for the young and healthy, who can live in a more crowded situation, cause the increase?

Such being the facts, national economy demands a reason.

Respectfully yours, AMOS EATON.

3. *On shooting stars.*—Prof. Silliman.—*Dear Sir*—The transparent vapor, which was described in the last number of your Journal as the basis of the aurora borealis, unquestionably exists in various tracts of the atmosphere, independently of latitude. It possibly gathers in larger quantities towards the pole, but the principal reason why it appears more luminous and extensive as we recede from the equator, is its relative position to the solar light.

While examining the causes of the aurora borealis, I became convinced, that shooting or falling stones are derived from the same origin. A flake of the vapor, which forms the basis of the aurora, by reflecting the light of a star, vertical or nearly so to its apparent place, becomes an image of the star, and while it remains quiet is not distinguishable from others in the hemisphere. When an aerial current crosses it, it is immediately removed from the direct rays of the particular star whose image it reflected, and disappears, or in common phrase, goes out, in the same way that the streams and flashes of the aurora vanish by changing their relative positions to the source of illumination.

Falling stars descend diagonally, unlike the aurora of these latitudes, which undulates, or shoots upwards when it moves at all; but in the northern regions its motions are very often lateral, and in some instances it falls perpendicularly. The levity of the vapor in the aurora is one of its characteristics, and the increase of its specific gravity so far as to cause its descent, is an exception to its prevailing condition; in the star, however, as in the descending aurora, the vapor becomes surcharged with moisture, or its elements form some new combination sufficient to overcome in part, its buoyancy, and the resistance of the atmosphere. And this is consistent with the laws which regulate the clouds, which at one time float in the air, and at another descend. We cannot follow the erratic movements of this vapor after it leaves the position where the lines of light disclose its existence, because it is invisible except when locally luminous in the night; and whether it is dispersed in the expanse of the heavens after it disappears from our sight, or whether it combines with the clouds, or becomes itself a cloud, or whether by parting with its superfluous moisture it retains its gaseous and invisible identity is unknown.

Shooting stars increase in number and frequency towards the equator, as the aurora increases towards the pole. M. Humboldt describes them as being innumerable over the seas between Maderia and Africa. Within the tropics they are seen only in a serene and azure sky, and often leave a train behind them for several seconds, always impelled by the wind, and shooting in the direction to which it blows, which latter fact, strongly indicates their meteorological origin. The sudden dispersion of the luminous particles, causes the gleams and shivers which appear like a pale blaze or train in the line of their descent. M. Arago passed whole nights in watching these beautiful meteors with intense and philosophic interest. His observations mark the same results, particularly their fidelity to the direction of the wind. He states that in some instances they fell in one course for several consecutive hours, and changed their direction when the wind shifted, always obeying its variations however small, and to whatever point it veered. With great respect, I am Sir, yours.

New York, March, 1831.

4. *Compendium of American Ornithology*, by Thomas Nuttall, A. M., F. L. S., &c.—Messrs. Hilliard & Brown, booksellers to the University of Cambridge, have issued proposals for the above work, with a specimen illustrative of the same; and they wait only for a moderate subscription to be formed, in order to commence the publication. The work will embrace "*a general history of all the birds indigenous to the most extensive limits of the United States, and of Canada; with their habits, manners, uses, and systematic arrangement, illustrated with faithful and original delineations of about two hundred of the most important species:* to be printed in royal octavo, upon good paper, and to be comprised in two closely printed volumes, in a good sized type, and to be delivered to subscribers in half volumes, or numbers, as they are completed. The price to subscribers will be $5.00 a number, or, with colored plates, $6.50." The names of subscribers are desired previous to the 1st of May, 1831.

We take much pleasure in announcing the foregoing proposals; feeling that a work, which can be afforded at a moderate price, upon this delightful branch of natural history, is a great desideratum; and having the utmost confidence in the ability of its author. No individual has been more favored than Mr. Nuttall, in opportunities for observing the habits of our birds. He has traversed, repeatedly, the whole extent of the United States, and has passed entire years in the natural resorts of the feathered tribe. His character as a philosophical naturalist will be a sufficient pledge for the scientific arrangement of the work; and his well known attainments in botany will enable him to do greater justice to his subject than most writers on ornithology: while the easy manner in which he expresses himself in describing natural objects, will, we doubt not, approximate his descriptions, for popular interest, to those of the celebrated Wilson.

5. *Elements of Physics, or Natural Philosophy, General and Medical; explained independently of technical Mathematics. In two volumes. Vol. II. Part I. Comprehending the subjects of Heat and Light;* by Neil Arnott, M. D., of the Royal College of Physicians. First American, from the first London edition. Carey and Lea, Philadelphia.—The second volume of Dr. Arnott's Elements of Physics, so long and impatiently called for, has just issued from the press of Carey & Lea. The first volume appeared in London more than two years since, and has already gone through four editions in England, beside being reprinted in America, and in France, where it was translated, and accompanied with algebraical formulæ for the use of schools and colleges.

The first part of the second volume treats of heat and light, and as regards these branches, may be deemed a "royal road to science," for the explanations are so clear and familiar, as to be perfectly intelligible to such as are not skilled in technical learning.—Prefixed to this volume is an appendix, in which the cause of stuttering or stammering is explained, and a simple remedy suggested, which, by the author, is considered effectual.

In a practical view, it is a work of great value. It instructs the artisan in the nature of heat; qualifies him to apply and control it, and to convert its most terrible force into a quiet and manageable working power. In the language of the author, "the element of heat in its tranquil and invisible diffusion, is the life and soul of the universe; the cause of seasons and climates, and of all the changes and activity which distinguish a living world from a dead and frozen mass. Fire, in man's service, may be figured as a legion of spirits, to whom no labor is difficult. In every private dwelling he has these spirits as his domestic servants; in his manufactories they are melting glass, reducing ores, and boiling and evaporating for an hundred purposes. But it is chiefly while chained to the steam engine that they put forth a giant's strength, heaving a river from the bottom of a mine, or urging a vast ship through the winter storm." Equally admirable is the "nice dexterity with which they twist the silk or cotton threads, and weave them into the most delicate fabrics." The work elucidates, as far as they are known, the hidden principles of this element, whether cheering and comforting man on the blazing hearth, and warming the apartments of his dwelling; or in the mild breath of spring; or in the ripening influences of summer; or in its indispensable, though mysterious union with animal and vegetable life. Nor is a knowledge of the laws which regulate the operations of Light, without practical importance, for, although it does not possess the working power of heat, *the philosophy of light* is essential to the painter, the astronomer, the architect, the optician and the naturalist; and is not without its uses in many of the common arts of life. Nothing displays the beneficence of the Creator more than the gift of this element, with the precious and perfect organ of sight, which he has adapted to receive and appreciate it. Aside however from its utility, light is one of the most interesting subjects of contemplation. Without it there were no beauty, no color, no perception of grace or proportion, or form. All the glories of the universe were a blank; and man, with his capacities for improvement—second only to the angels—elevated to the heavens by his intellectual endowments, must have groped through the long night of his existence, "with wisdom at one entrance quite shut out."

The second part of this volume is promised soon to succeed this, and will comprise the subjects of Astronomy, Electricity and Magnetism.

December 31st, 1830.

6. *Buffalo Mineral Spring.*

Extract of a letter from Dr. M. Bristol to the Editor, dated August 11, 1830.

Dear Sir—I have taken the liberty of sending to you six bottles of water, from the Seneca spring, about four miles from our village, upon the Indian lands. It has long been familiarly called the Deer Lick, because deer used to resort to this spring for drink, preferring it to common water, on account of the salt it contains. There are several of these springs, issuing from opposite sides of the stream upon which they are situated; considerable gas issues constantly from them, which is inflammable. The sensible properties of these waters resemble very much those of the Avon springs, upon the banks of the Genessee River, a few miles from Mr. Wadsworth's. I will thank you to analyze this water, which appears so similar to the Avon springs. The latter are resorted to considerably by invalids, and I am inclined to think that these possess equal and similar virtues.

Chemical Examination, by Mr. C. U. Shepard, Assistant in the Chemical Department of Yale College.

This is a sulphureous water, as is perfectly obvious to the smell and taste.

A. Twenty four ounce measures of the water boiled in a retort for half an hour, gave over two and a half inches of gas, which appeared to be a mixture of sulphuretted hydrogen and azote. It possessed the odor of the former of these gases, and extinguished a lighted match, which was introduced into it. The water, after boiling, exhibited a copious precipitate and still continued to emit the odor of sulphuretted hydrogen gas; the smell of which was increased upon the addition of a little sulphuric acid, from which circumstance it appears probable that the sulphuretted hydrogen is not wholly free, but in part engaged with a basis, probably lime, in the form of a hydrosulphuret.

B. Litmus paper, introduced into the water before boiling, was unchanged; but after being first reddened by a little acid, it had its blue color restored; indicating the presence of *carbonate of soda* or potash. Tincture of alkanet was immediately changed to blue, by the boiled water.

C. Muriate of lime gave a precipitate with the water, proving the presence of carbonate of lime.

D. Muriate of barytes gave a precipitate with the water, proving the presence of a sulphate or carbonate, probably lime, the substance precipitated by boiling (in A.)

E. Nut galls and prussiate of potash, gave no indications of iron.

F. The addition of muriatic acid produced a distinct effervescence in the water, owing either to sulphuretted hydrogen or carbonic acid, or to both.

G. The addition of carbonate of ammonia, and afterwards of phosphate of soda, gave a copious precipitate, proving the existence of *carbonate of magnesia.*

It appears then to be a strong sulphureous water, free from any uncombined carbonic acid, and containing notable quantities of the carbonates of lime, magnesia and soda, together with sulphate of lime.

Sept. 4, 1830.

Remarks by the Editor.

I am not aware that the Avon water has been analyzed, but judging from its sensible properties, which I had an opportunity of observing at the spring in October, 1827, I should think it decidedly of the same class with the Buffalo water, and from the geological structure of the country in that region, it is highly probable that the springs have a similar origin.

At Avon, I observed that the silver watches of the attendants were rendered almost perfectly black, by the influence of the fetid gas, pervading the apparel and filling the air around, for a considerable distance, with the characteristic odor.

7. *Loss of vessels in the Gulf Stream.*—In noticing frequently the loss of vessels coming from sea, by their running on shore before the captain supposed he was near it, it appears to me that such loss might easily be avoided, by the use of the thermometer to get the temperature of the water, which is always colder on soundings than off soundings. I came upon our coast last April, from the West Indies, with dull hazy weather; and the captain told by the thermometer, very accurately, when he got upon soundings.

We crossed the Gulf Stream on the 19th, in lat. 36°; the temperature of the ocean to the eastward had been 66° to 68°, in the Gulf Stream it was up to 75°; the air at the same time was 61°; as soon as we had crossed the Gulf Stream, the temperature of the water was down to 62°; air 62°. Lat. 38°, next day, the water was down to 58°; air 59°. Lat. 39°, the water continued near 58° through the day, until at eight in the evening we found it to be only 42°; the captain immediately said he was on soundings; he ordered the lead to be thrown and found bottom accordingly, at the depth of forty three fathoms. He threw the lead every two hours during the night, until at three in the morning he had twenty two fathoms, and at four he had only seven fathoms, which placed him upon Nantucket South Shoal. He immediately tacked ship and in fifteen minutes run out into deep water, and the next day arrived in Boston. The temperature of the ocean from Nantucket to Boston, taken every hour, was 41° to 44°. *A passenger on board.*

New York, Dec. 8, 1830.

8. *Improvement in the Reflecting Goniometer; by* A. Eaton.—Whoever has used the reflecting goniometer, has experienced considerable inconvenience in adapting some crystals to the instrument, by the use of the common crank, &c. Four years ago, I directed an artist in this city to make a reflecting goniometer, with an

axil an inch and a fourth in diameter, without any crank. I have now used it constantly in this school, and the students have used it continually, for four years, with a substitute of the common adhesive substance, called diachylon by the druggists. This we mould into a form adapted to the mineral to be examined. A slender cylinder of it, with one end adhering to the broad end of the axis on one side of the center, arching so as to bring the angle to be measured in a line with the center, is required for a small crystal. A large crystal, or any crystal which adheres to a large mass of its gangue or embracing rock, requires a large piece of the diachylon, covering one side of the end of the axis. A mineral weighing several pounds, or only the fourth of a grain, may be thus fixed to the instrument, at the pleasure of the operator.

Rensselaer School, March 3, 1831.

9. *Mapping Instrument.*

TO PROF. SILLIMAN.

Several mapping or plotting instruments having been recently proposed, and perhaps will be patented; please to permit the following paragraph to go out in your next number.

Any artist shall be welcome to the right of an invention of my own, of a mapping instrument, which received considerable attention about twenty years ago; but was never brought into extensive use. One of the instruments was presented by myself to President Day, in the year 1816, when he was professor of natural philosophy. He told me afterwards that he had deposited it with the College apparatus, where, I presume, it may now be seen. This instrument performs the office of scale, dividers, parallel ruler, and protractor; and it does not contain a joint. One may conceive of the construction of this instrument, by imagining one end of a six inch scale, brazed to the middle of the straight side of a common protracter, and the scale open in the middle, half an inch in width, from the brazed end to near the other end—then imagining a slide to run in that opening with a graduated nonius, and the graduations fitted to the decimal divisions of an inch on the scale. A prick-point fixed to the under side of a spring, attached to the slide at the end, towards the brazed end of the scale, completes the instrument. Yours respectfully,

AMOS EATON.

Troy, March 3, 1831.

10. *Mechanics' Magazine and Journal of public internal improvement.*—This useful and commendable work is published by Mr. Samuel N. Dickinson of Boston, and the first volume containing 384 pages 8vo. is just finished. It is neatly printed on a good paper, and is furnished with good figures, chiefly from wood, for the various subjects which require that species of illustration.

Dr. Jones has for several years conducted, very successfully, the Franklin Journal, published at Philadelphia; and New York, has at times, been furnished with a Mechanics' Magazine, but we do not recollect that a similar attempt has been made in Boston before the present.

On looking through the pages of the Boston Journal, we find that they contain much valuable matter both original and selected, and that the Magazine is both an instructive and attractive work. The editor has honored the American Journal by occasional selections, and we are happy if any thing in our pages may be esteemed sufficiently valuable to obtain in this way a wider circulation, and an opportunity of effecting more good. We regret to learn that Mr. Dickinson's patronage is not at present sufficiently extensive to meet his inevitable expenses, but we trust that a second year will remedy this difficulty, and that Boston will not permit its Mechanic's Magazine to languish for want of adequate patronage.

11. *Asbestos impregnated with platinum.*—I find that if asbestos or charcoal be soaked under an exhausted receiver in muriate of platinum, then dried in an evaporating oven for twenty fours hours and afterwards ignited, the property of ignition in the gaseous elements of water is acquired.—*From a letter of Dr. Hare.*

12. A new 8vo. monthly Journal, called The American Botanical Register, is announced for publication at the city of Washington; it will contain the description, specific character, culture, history, and application in the arts, of the plants exclusively indigenous to America; together with the systematic and common synonyms, the scientific names accentuated, and their etymology explained. The whole arranged according to the Linnæan system, and the natural orders of Linnæus and Jussieu, with references to figures and the standard authorities, for the description of each individual plant.

The letter-press will be in English, and illustrated with accurate engravings of every plant described, colored from nature.

To be edited by William Rich and John A. Brereton, M. D. U. S. Army, assisted by scientific gentlemen.

Each number will contain eight colored engravings, and every third number an extra plate, forming an annual volume of one hundred colored engravings, descriptions of plants, &c. &c. Subscription—Twelve Dollars per annum.

13. *Floating Pumice.**—*Extract of a letter from Mr. A. A. Hayes to the Editor.*—An interesting specimen of an unusual variety of pumice,† was exhibited a few weeks since in Boston, and excited considerable attention. I was permitted to detach a fragment for examination, but as it was readily separated by mechanical means, into three distinct minerals, whose composition is known, an analysis of the specimen was not made. About nine-tenths of the bulk of the specimen is a white, vesicular transparent mineral, fusible per se, and with fluxes acts as a siliceous feldspar. One-hundredth of the bulk is black mica, in small, and often minute scales; the remainder perfectly inclosed in the first, consists of crystals, and grains of white transparent quartz; a regular form had been given to the specimen by artificial means.

14. *Bromine.**—(From Mr. A. A. Hayes to the Editor.)—In a former No. of the Journal, I observed in your communication of the discovery of bromine in the waters of Salina springs, the interesting fact, that the bittern from the Connecticut salt works does not contain bromine. Is it possible that the presence of some other substance causes its separation in a state of combination, from the water in the process of evaporation, or are we to conclude that the salts of hydro-bromic acid, are more abundant on some coasts than on others? The bittern from the salt-works near Hingham, Mass., contains bromine, and it may be readily detected by the usual processes.

15. *American Birds.*—We are informed that Audubon's work on American birds has arrived for the Atheneum in Boston. It exceeds the most sanguine expectations of Mr. Nuttall, and all who have seen it.

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* These notices were prepared for a former number, but were accidentally postponed.

† Mentioned in a letter from John Tappan, Esq. to the Editor, as having been found floating at sea in a very large mass.

16. *Abstract of a Meteorological Journal, kept in the town of New Bedford, for the year* 1830.

	Arithmetical mean of observations for each month, at the hours designated.									Rain & snow. reduc'd	Extremes of temp. and atmospheric pressure.				Prevail'g winds noted in days.				Atmosphere.			
	Six's self-registering therm.					Standard Barometer.					Therm.		Barom.		N & NW	W & S W	S & S E	E & N E	Fair.	Cloudy.	Rain.	Snow.
MONTHS.	S.R.	2c'k	S. S.	10cl	m'n	S.rise.	2 o'clk	Sun st	10oc'l.	inches.	max.	min.	max.	min.								
January,	24.7	32.1	29.8	27.4	28.5	29.931	29.887	29.897	29.917	3.73	51	—4½	30.45	29.15	13	13	1	4	18	7	5	1
February,	22.7	32.4	29.2	25.8	27.5	29.933	29.896	29.928	29.946	2.73	48	—½	30.55	29.44	16	4	1	7	16	8	2	2
March,	32.3	43.1	38.7	35.1	37.3	29.997	29.969	29.970	29.983	4.24	65	19	30.56	28.76	7	13	6	5	16	8	5	0
April,	40.8	54.2	48.1	44.1	46.8	30.105	30.098	30.108	30.118	2.00	75	33	30.51	29.57	5	7	2	16	15	8	7	0
May,	49.4	64.0	56.7	52.5	55.6	30.022	29.999	30.003	30.023	5.89	71	39	30.28	29.71	7	13	9	2	17	6	8	0
June,	58.4	73.4	65.2	61.8	64.7	29.893	29.864	29.874	29.893	3.30	86	49	30.22	29.44	4	19	4	3	16	4	10	0
July,	66.0	80.2	71.7	68.3	71.3	30.017	30.012	30.015	30.026	10.67	92	55	30.28	29.69	6	13	5	7	16	9	6	0
August,	62.9	76.5	69.6	66.1	68.8	30.004	29.993	29.995	29.998	5.53	85	57	30.27	29.53	5	14	8	4	19	7	5	0
September,	55.3	66.7	61.0	57.4	60.1	30.092	30.078	30.094	30.109	4.62	78	38	30.43	29.56	5	12	4	9	16	9	5	0
October,	48.1	58.7	55.0	52.0	53.4	30.101	30.073	30.069	30.085	3.15	70	33	30.44	29.69	5	11	5	10	20	7	4	0
November,	45.5	51.7	48.8	46.7	48.2	30.057	30.054	30.039	30.049	5.49	62	32	30.51	29.54	7	4	4	15	10	7	13	0
December,	33.8	39.8	36.7	35.1	36.3	29.892	29.849	29.875	29.875	6.13	58	6	30.51	29.08	12	8	7	4	15	7	6	3
The year.	45.0	56.1	50.9	47.7	49.9	30.004	29.981	29.989	30.018	57.48	92	—4½	30.56	28.76	92	131	56	86	194	87	76	8

17. *Mauch Chunk Anthracite mines.*—From the report of the board of managers of the Lehigh Coal and Navigation Company, and that of the acting manager, Mr. White, it appears that the new mines mentioned in the 19th Vol. of the Am. Jour. are about to be opened. A rail way of four miles will bring the coal to Mauch Chunk village, and arrangements are making for sending to market one hundred thousand tons during the ensuing season. The company's grand canal is finished and in perfect order to Easton, and nothing is necessary but the completion of the canal along the Delaware to Philadelphia, and of those across New Jersey to New York, in order to give the Lehigh coal a full access to market. Three hundred thousand tons of coal are uncovered at the great mine and ready for quarrying.

18. *Indiana Historical Society.*—This association was formed Dec. 11th, 1830, and it embraces in its design the natural, civil, and political history of Indiana and the promotion of useful knowledge generally. The regular seat of the society is at Indianapolis, but the corresponding secretary, John W. Farnham, resides at Salem, Washington county, Indiana, to whom communications may be addressed. In the list of officers we observe the names of gentlemen whose reputation affords a satisfactory pledge that they will give all practicable efficiency to the society, whose objects are of the most laudable kind, and we rejoice to see such institutions springing up in the west, as fast as civil society advances.

19. *Notice respecting Steam Boats.*—In reference to the method of ship building described page 14 of this No. I am authorized to say, that Mr. Brindley will undertake to build steam boats or vessels of any burden according to this system—and will, through me, furnish any estimate desired; having in England built a considerable number of these vessels. They combine the good properties of strength, lightness, and durability. When intended for steam boats, I would engage to have them fitted up with engines from one of the first manufactories here, including the safety apparatus and auxiliary fire described in this number. J. L. SULLIVAN.

20. *Professor Hitchcock's lectures on diet and regimen.*—A new, enlarged and improved edition of this valuable work has been recently published; its tendency is decidedly good, and we are glad to find that the demand for it has been so great as to require a new edition within the first year.

21. *To mineralogists, geologists, &c.*—H. H. Hayden, Esq. author of Geological Essays, having on hand a number of volumes of the above work, requests us to propose to the mineralogists of the United States, an exchange of one or more copies, for an indefinite number of the minerals of their respective districts. Mr. H. not being aware of the value at which some persons may estimate minerals, has mentioned an *indefinite* number, leaving it discretionary, and entirely to the liberality of those who may feel a desire to possess the work. He hopes, however, that it will not be undervalued by those who know how to appreciate the labor, and unavoidable expense necessarily required in its prosecution. To any person or persons wishing for one or more copies, Mr. H. will send them to any part of the United States, free, as far as practicable, of all expense, and will, likewise, incur the expense of transport of such minerals as may be sent in return. Mr. Hayden adds:—

"In my visit to the gold regions I found, at several of the mining locations, that what many called a mica slate, was in fact a *talcose* slate. Mr. Keating is now on a tour to the Floridas, taking the gold region in his course. A few days since he wrote me from Charlottsville, Va.—He informs me that he has *crossed* the gold region and has visited several of the mines, and finds that the rock in which the veins occur is "a talcose slate." With such authority to support me, I think my word may pass current."* *Baltimore*, Md.

22. *Reflections on the decline of Science in England; by Charles Babbage, Lucasian Prof. of Math. in the Univ. of Cambridge.*—Some notices in the English Journals had prepared us for this volume† of 232 pages. Even if the task were a grateful one, we have neither time nor room to present an analysis of this work. We confess we cannot be gratified by learning that the Royal Society of London, so long admired and venerated, is in a state of dotage, and that it is abused for purposes of personal ambition and aggrandizement. It becomes its members, however, to vindicate themselves from the charges which Prof. Babbage, openly and fearlessly, brings against them, as well as against other societies and distinguished individuals. His

* It will be observed that this view coincides with Prof. Eaton's opinion, expressed in this and a former number.—*Ed.*

† Received through the kindness of a friend in London. We have also received a pamphlet of 23 pages, (second edition,) containing thirty six charges against the president and councils of the Royal Society, by Sir James South, a member, who, in anticipation of a possible result, concludes by saying, that "*where admission is no honor, expulsion can be no disgrace.*"

arrows fly from no uncertain hand; he stands forth avowed, and directs his artillery at men and institutions of the greatest celebrity. If his satire is caustic, his irony cutting, his playfulness provoking; they are not the less so on account of the constant appeals which he makes to facts, documents and living witnesses.

We pronounce, for the present, no opinion on this remarkable volume; it cannot however fall to the ground, *mere brutum fulmen;* it must *tell*, in some way or another; either by a recoil upon the author, if his case is not made out, or by a salutary operation upon the high institutions and individuals who are so powerfully assailed.

The following tariff of admission to some of the principal societies, we quote simply as a statement of facts, remarking only, that however proper or necessary it may be thus to raise a revenue at home, we should hardly have expected the same terms to be prescribed to foreigners, to whom membership is indeed a gratifying honor, but cannot afford much positive advantage.*

Societies.	Fee of admission, including composition for annual payments.		Appended letters.
Royal Society,	£50	0*s*	F. R. S.
of Edinburgh,	25	4	F. R. S. E.
Academy of Dublin,	26	5	M. R. I. A.
Society of Literature,	36	15	F. R. S. Lit.
Antiquarian,	50	8	F. A. S.
Linnæan,	36		F. L. S.
Geological,	34	13	F. G. S.
Astronomical,	25	4	M. A. S.
Zoological,	26	5	F. Z. S.
Royal Institution,	50		M. R. I.
Royal Asiatic,	31	10	F. R. A. S.
Horticultural,	48	6	F. H. S.
Medico-Botanical,	21		F. M. B. S.

Mr. Babbage remarks, that "those who are ambitious of scientific distinction may, according to their fancy, render their name a kind of comet, carrying with it a tail of upwards of forty letters, at the average cost of £10 9*s* 9¼*d* per letter."

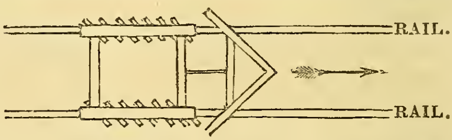
* We do not know that *the demand of money*, from foreigners, is universal with English learned societies; we know however that some of them enforce this demand. Nor are we certain how far other European societies pursue this course, but we have not known any instance of money being required out of Britain, where honor was conferred.

23. *Purification of olive oil, for chronometers, &c.*—(H. Wilkinson, in Trans. Soc. of Arts, &c. Vol. XLVIII, p. 43.)—The best olive oil, in considerable quantities, is kept in jars for one year or two, (in a state of repose,) during which time most of the water and mucilage subside. Two or three gallons are skimmed from the surface of a large jar, and afford better oil than any subsequent portion. One gallon being placed in a cast iron vessel of twice that capacity, is heated for one hour, over a slow clear fire, to 220°, and must never be hotter than 230°, nor descend below 212°. Thus the water and acetic acid are evaporated. The oil is then exposed to a cold of 30° to 36°, for two or three days; (winter is of course preferable;) the congealed portion is separated by a muslin filter; the solid part may be used for common purposes, and the fluid part is then filtered through newly prepared animal charcoal, coarsely broken, and sustained on bibulous paper, in a wire frame, within a funnel; this removes rancidity, if any is present, and the oil becomes perfectly bright and colorless.

Messrs. Barraud and son, (the celebrated chronometer makers in London,) attest that this oil is superior to any other, and that they have used no other for the last four or five years.

The process is simple and easy, but it demands considerable time; it has been used by the discoverer for ten or twelve years.

24. *Method of clearing the Baltimore rail-way of snow during the late winter.*—It was invented by Mr. Winans, and consists of an angular frame, shod with iron,



followed by a sled, shod with irons *oblique to the line of the runners;* the first pushing the snow each way off; the latter scraping snow and *ice more closely*, as the oblique irons in succession scrape the rails. It was drawn by five or six horses at a trot; and was effectual, though the snow was two feet deep on a level; in the deep passes, much more.—(*Communicated by Mr. J. L. Sullivan.*)

25. *Discourse, delivered before the Historical Society of Michigan, by Henry R. Schoolcraft.*—This discourse contains very interesting notices of the northern and interior portions of this continent, particularly in relation to the past and present condition of the aboriginal tribes; and of their connexion with, and relation to, the French, English and Anglo-Americans. A historical society, whose

anniversary is thus ably commemorated in a place which, within the memory of persons still living, was regarded as scarcely an "out-post of civilization," is an object of peculiar interest; and the state of useful arts there is sufficiently indicated by the beautiful paper and typography of this discourse. Detroit, with its dawning literature, has, however, the honor of affording a retreat to a venerable and accomplished scholar, jurist and poet; the only survivor of a brilliant circle, who adorned the early literature of their country, which will never forget the names of Trumbull, Dwight, Humphreys and Barlow, the first of whom only survives; *clarum et venerabile nomen.**

26. *Encyclopædia Americana.*—The fifth volume of this work is just published. Our impression, derived from an examination of a few articles in this volume, relating to Natural History, Chemistry, General Physics, &c., is equally favorable as that expressed in relation to the first volume. As specimens in these departments, in the present volume, we would refer our readers to the articles *Galvanism*, *Geology*, *Granite*, *Feldspar*, *Fluor* and *Garnet.* The mineralogical articles, in particular, are drawn up with precision and skill, are sufficiently full, for such a work, and are brought down to the present time. A great amount and variety of useful knowledge are compressed in this Encyclopedia, which deserves and cannot fail to have an extensive circulation.

27. *Crystallized Carbon.*—Dr. C. C. C. Cohen, of New York, in company with Mr. J. Boston, while passing vapor of alcohol through an ignited iron tube, for the purpose of forming pure carburetted hydrogen gas, obtained a large deposit of charcoal, among which "were several specimens of perfectly bright needles of crystallized carbon," resembling that obtained while passing carburetted hydrogen gas over ignited iron, for the purpose of converting it into steel, and described in Henry's Chem. 11th ed. Art. *Carbon.*—(Letter to the editor, March 22, 1831.)

28. *Horticulture.*—This elegant and useful art is constantly receiving increased attention in this country, and in many places has already attained great excellence, as appears from the rich display of esculent, as well as ornamental productions, made at the horticultural exhibitions.†

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* Which Mr. Walsh has recently applied, with equal felicity, to another literary and legal ornament of his country and of his age.

† That of Philadelphia, in June, 1830, which we saw, was very splendid.

We notice also, with pleasure, a valuable horticultural Repository, published monthly in New York, and various occasional addresses, containing interesting facts and details: that of Dr. J. W. Francis, delivered in September, in New York, is a rich and elegant document; and that of Mr. G. W. Clinton, pronounced at Canandaigua, in the preceding June, exhibits a vigor and spirit for improvement, creditable to the writer, and the fine region of western New York.

Among the publications that commemorate the productions of our great gardens, those of the Messrs. Prince, possess much interest and value.

29. *Literary and scientific societies of Canada.*—We have had occasion, repeatedly, to notice the promising and already successful efforts which are making to promote science in Canada. We understand, from a correspondent at Kingston, that a second volume of the Transactions of the Literary and Historical Society of Quebec, may be soon expected.

The last report which we have seen of the Natural History Society of Montreal, dated May 31, 1830, exhibits a sound and vigorous growth of that institution, which is evidently under a wise and liberal direction.

We wish all success to our intelligent neighbors in their meritorious efforts, which it will be always a pleasure to promote in any way in our power.

30. *Affinity of the Diallage family, in chemical constitution, with augite.*—Fr. Köhler has given (*Poggendorff*, *Ann.* XII. 101) the results of a mineralogical and chemical examination of the species Metalloidal Diallage, Bronzite and Hypersthene, from which he infers their general identity with augite; to which species he refers them, under the denomination of the Schiller spar family.—(*Zeitschrift für Mineralogie*, Nro. 5. Mai. p. 386.)

31. *Collections of Insects.*—M. J. L. Laporte, of Bordeaux, in a letter to Dr. J. Porter, of Plainfield, Massachusetts, states, that he is engaged in a work upon the insects of both Americas, and that he is therefore anxious to receive insects of every species from all parts of North and South America. He requests particularly that the butterflies may be put up in paper triangles, that they may arrive in the best state. He promises liberal returns in insects from

the eastern continent, particularly from Europe and India; or, if more agreeable, he will send plants and shells.*

The following letter from M. Laporte to Dr. Porter, expresses his views more fully.

"I am very much gratified to learn that the little collection of insects which I sent you gave you pleasure; and I repeat my offers, to send you, not only a large proportion of all the species of Europe, but likewise those of India and other countries. I will also send you, if you desire it, plants, both in the phanerogamous or cryptogamous department, as I possess many duplicates duly prepared.

"I can also send specimens in conchology, either sea, land, river or fossil shells.†

"My brother, being particularly engaged in ornithology, would be alike desirous of entering into correspondence with any naturalists, who collect birds: he would be able to furnish many specimens.

"I desire, above all things, to receive insects, of whatever order they may be; and, as I am engaged upon a work concerning those of the two Americas, it is indispensable that I should receive not only a large number, but from different localities. For this I shall be disposed to make numerous sacrifices, in order to indemnify my correspondents for the pains they may take to assist me in my researches; I shall therefore feel very grateful to you, if you will have the goodness to attend to my request; and I desire you more especially to put up the lepidopterous insects in paper triangles, that they may arrive in the best state.

"I do not consider it indispensable to have the insects, that may be sent me, classed, but only every variety, as far as possible, of the different species, by having several specimens of the same put up. This would be of great advantage to me.

"If, among the number of species that I have sent, or may hereafter send you, some of the same should be found also with you, I request that you would not, on that account, neglect sending them to me.

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* M. Laporte requests that whatever is intended for him may be forwarded direct to Bordeaux, and not by the way of Havre. His address is, *M. J. L. Laporte, Tresorier de la Société Linneenne de Bordeaux, Rue du Parlement, No. 13, à Bordeaux.*

† With respect to minerals, I have but few duplicates.

"The great number of insects, which it is in my power to send to your country, affording me the assurance that I can satisfy several correspondents, induces me to request that you would make some overtures in my favor, so as to bring me into connection with such entomologists of your acquaintance, as may be desirous of making exchanges. I recommend this measure more particularly with respect to the naturalists, that live in countries, that you may not be able to visit. You may reckon beforehand on all my efforts to testify my gratitude, which will always be something more than a mere equivalent for the pains that you and your friends may take in my behalf."

32. *Localities of Minerals, by Jacob Porter.*—*Spodumene,* in coarse grained granite, with beryls, near the celebrated locality of the tourmalines, Chesterfield, (Mass.) The crystals are very large, many of them having a delicate apple green color. *Red oxide of titanium,* in fine crystals, near the soap-stone quarry, Cummington, Mass.

33. *Trap, and rocks altered by it.*—Professor Leonhard, of Heidelberg, Germany, in a letter to the editor, dated May 22, 1830, remarks, that he had been much interested in the account contained in the 17th volume of this Journal, of the changes which the trap had produced upon the sand-stone in the vicinity of Hartford; and he is disposed to call the sand-stone the *variegated.* He adds, "I have been occupied several years in similar researches, and have visited most of the mountains of Germany that are interesting in these respects: I have also gone over Auvergne and Velay, and in all these places I have made a rich collection of a great diversity of rocks, which I have seen in contact with basalt or with dolerite, and which prove the different degrees of alteration produced by the heat. I intend to publish—perhaps the next year—a work upon this subject."* We will only add, that after such extended and varied observations, Prof. Leonhard's work will be highly acceptable to geologists.

34. *Sir Humphrey Davy's Consolations in travel.*—Throughout the whole of this interesting volume, we observe traces of the most genuine unaffected piety, and the most complete proofs, that the author had studied, in his latter days at least, the peculiar doctrines of

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* In two vols. 8vo. with numerous sections and maps: it may be expected during the present year.—*Prof. Jameson, Edin. Jour. Dec.* 1830.

christianity, and derived from them that consolation which they are so well fitted to inspire. It is a proud triumph of the christian faith, that the greatest chemical philosopher of modern times, should not only have added his testimony to its truth, but should have spent his latest hours in impressing his convictions upon others. There perhaps never was an individual who rose more quickly than Sir H. Davy to the highest objects of ambition. Placed in the chair of Newton, at the head of the Royal Society, honored by the special notice of his sovereign, associated with the highest ranks of society, and distinguished over all Europe, as the most successful of modern inquirers, he yet found that there was something beyond all this, after which his soul aspired, and before which all earthly glory disappeared.

"Religion," says he "whether natural or revealed, has always the same beneficial influence on the mind. In youth, in health and prosperity, it wakens feelings of gratitude and sublime love, and purifies at the same time that it exalts; but it is in misfortune, in sickness, in age, that its effects are most truly and beneficially felt; when submission in faith, and humble trust in the Divine will, from duties become pleasures, undecaying sources of consolation; then it creates powers which were believed to be extinct, and gives a freshness to the mind, which was supposed to have passed away for ever, but which is now renovated as an immortal hope; then it is the *Pharos* greeting the wave-tossed mariner to his home, as the calm and beautiful still basins or *fiords* surrounded by tranquil groves and pastoral meadows, to the Norwegian pilot escaping from a heavy storm in the North Sea, or as the green and decoy spot gushing with fountains to the exhausted and thirsty traveller in the midst of the desert. Its influence outlives all earthly enjoyments, and becomes stronger as the organs decay and the frame dissolves; it appears as that evening star of light in the horizon of life, which we are sure is to become in another season a morning star, and it throws its radiance through the gloom and shadow of death."

We would strongly recommend this volume, not only to the study of scientific men in general, but especially to those who are just entering upon their philosophical career. At that dangerous period when presumption and scepticism are the attendants of knowledge, it will not be an unprofitable lesson to read in the lives of Newton and of Davy, that in minds of the highest order, humility and piety are the genuine offspring of true science.—*Dr. Brewster's Journal.*

(The following articles were extracted by Prof. J. Griscom.)

STATISTICS.

1. *National Encouragement of Science.*—The following circumstances are stated by Charles Babbage, M. A. F. R. S. L. and E., Professor of Mathematics, Cambridge, in his work " on the decline of Science."

Examples of a few of those men of science, who have formerly held, or who now hold, high official stations in the governments of their respective countries.

Country.	*Name.*	*Department of Science.*	*Public Office.*
France	Marquis Laplace*	Mathematics	President of the Conservative Senate.
France	M. Carnot	Mathematics	Minister of War.
France	Baron Cuvier†	Comparative anatomy, Natural History	Minister of Public Instruction.
Prussia	Baron Humboldt	Oriental Languages	Ambassador to England.
France	Count Chaptal‡	Chemistry	Minister of the Interior.
Prussia	Baron Alexander Humboldt	The celebrated traveller	Chamberlain to the King of Prussia.
Modena	Marquis Rangoni‖	Mathematics	Minister of Finance and of Public Instruction, President of the Italian Academy of Forty.
Tuscany	Count Fossombroni§	Mathematics	Prime Minister of the Grand duke of Tuscany.
Saxony	M. Lindenau¶	Astronomy	Ambassador.

* Author of the *Mecanique Celeste.* The first Vol. of the first translation of this celebrated work into our language, has just arrived in England from —— America!

† Author of *Leçons d' Anatomie Comparé—Récherches sur les Ossemens fossiles, &c. &c.*

‡ Author of *Traité de Chimie Applique aux Arts.*

‖ Author of *Memoria sulle Funzioni Generatrica,* Modena, 1824, and of various other memoirs on Mathematical subjects.

§ Author of several memoirs on mechanics and hydraulics, in the Transactions of the Academy of Forty.

¶ Author of *Tables Barometriques,* Gotha, 1809—*Tabulæ Veneris novæ et correctæ,* Gothæ, 1810—*Investigatio Nova Orbitæ a Mercurio circa Solem descriptæ,* Gothæ, 1813, and of other works.

Comparative numbers of the Royal Society of London, the Institute of France, the Italian Academy of Forty, and the Royal Academy of Berlin.

Country.	Population.	Number of Members of its Academy.	Number of Foreign Members.
1. England	22,299,000	685	50
2. France	33,058,000	75	8 Mem. 100 Corr.
3. Prussia	12,415,000	38	16
4. Italy	12,000,000	40	8

Hence it appears that in France, one person out of 427,000, is a member of the Institute; that in Italy and Prussia, about one out of 300,000; and in England, every 32,000 inhabitants produce a Fellow of the Royal Society.

In France, the situation of its *savans* is highly respectable, as well as profitable.

	Number of the Members of the Institute who belong to the Legion of Honor.	Total number of each class of the Legion of Honor.
Grand Croix	3	80
Grand Officier	3	160
Commandeur	4	400
Officier	17	2000
Chevalier	40	Not limited.
	Of the Order of St. Michel.	Total Number of that Order.
Grand Croix	2	100
Chevalier	27	

Among the members of the Institute, there are—

Dukes	2
Marquis	1
Counts	4
Viscounts	2
Barons	14
	23

Of these there are Peers of France 5

Among the 685 members of the Royal Society, there might be found a greater number of peers than there are in the Institute of France; but a fairer mode (says the writer) of instituting the comparison, is to inquire how many titled members there are among those who have contributed to its *Transactions*. In 1827, there were 109 members who had contributed to the transactions of the Royal Society; amongst them were found:

Peer	1
Baronets	5
Knights	5

Five of these titles were the rewards of members of the medical profession, and one only, that of Sir H. Davy, could be attributed exclusively to science.—*Edinburgh Journal of Science, July,* 1830.

2. *Necrology.*—The president of the Academy of Sciences at Paris, announced at the session of May 17, the loss which they had just sustained in the death of M. Fourier, perpetual secretary for the mathematical sciences, and one of the most illustrious sçavans of the age.

The committee appointed at the succeeding session to nominate suitable persons to fill the important station thus left vacant, presented on the 31st of May. MM. *Arago, Puissant,* and *Becquerel,* and at a subsequent meeting, Arago was, by a large majority, elected perpetual secretary, in the room of his deceased colleague.—*Rev. Encyc.*

3. *State of Education in the City of Lyons.*—In the course of an extensive journey through the South of France, in the autumn of 1828, the benevolent savant Ch. Dupin, visited Lyons, and has furnished the Revue Encyclopedique with an interesting memoir on the commercial and moral condition of that city. From a census annually taken of the number of young men who arrive at the age of twenty, it appears that in 1827, the number of that class amounted to 835 in the city of Lyons: of these 285 knew how to read and write; 329 knew only how to read; 221 knew nothing. In the rest of the department of the Rhone, of 1919 young persons examined, 787 knew how to read and write; 139 knew only how to read; 993 could neither read nor write. The memoir farther observes,

At Lyons, more than a fourth part of the young people can neither read nor write. At Lyons, less than a third of the young people can write. At Lyons, more young persons are interrupted in the midst of a course of primary instruction, than are left to finish it; in other words, more than half the parents who send their children to the schools, gratuitous or otherwise, withdraw them as soon as they have learned to read, and without waiting until they can write.

They only means of remedying this evil, is to render primary instruction so rapid, as to teach the children reading and writing in the time now devoted to reading only, by the old and difficult method which they still pursue.—*Rev. Encyc. Avril,* 1829.

4. *Rail Roads in Austria.*—Within five years, three rail roads (chemins en fer) have been constructed in Austria by private companies. The longest is that from the river Moldau, in Bohemia, on the confines of Bavaria, to the Danube. Its length already exceeds 13,400 cordes; the corde being equal to six German feet. The building of several chain bridges is also under consideration. Indus-

try and commerce seem to have taken a fresh start, but the movement is very much confined to Austria.—*Rev. Encyc. Sept.* 1830.

5. *The last annual meeting of the Naturalists and physicians of Germany*, was held at Hamburg, in September last. This scientific reunion was founded in 1822, for the purpose of rendering the scientific men of Germany, acquainted with each other, and of facilitating an exchange of ideas and discoveries, and producing a union of efforts in favor of the progress of science. After having held their meetings successively at Dresden, Berlin, Frankfort, and Heidleberg. They decided on meeting at Hamburg, and the Senate of that city were the more gratified in receiving them as their Burgomaster, *Bartels*, one of the most learned and influential citizens, had been chosen President of the assembly. Every thing was done to give them an agreeable reception; the chamber of finance placed at the disposal of the President, funds sufficient to treat them in a style worthy of the occasion. *M. De Struve* the Russian Minister, a distinguished mineralogist, was invited to attend the meetings, and was placed at the head of the section of mineralogy.

The assembly consisted of upwards of 400 persons, among whom were Prof. *Berzelius* of Stockholm, *Agardh*, of Lund, Count *Sternberg*, of Prague, and others from Edinburgh, London, Copenhagen, Vienna, and even from Baltimore.

Prof. *Struve* pronounced a discourse, as interesting as instructive, on the merits of the Germans in Astronomy; and the director of the imperial garden at St. Petersburg, M. *Pischer* read a memoir concerning the foundation and actual condition of this garden so magnificently endowed by the emperor. At the last session held on the 26th September, they decided on motion of Count *Sternberg* to meet the next year at Vienna, it being understood that it was the Emperor's wish that his learned Society should meet in his capital. The sessions were conducted with great harmony, and the provision that had been made for dining parties and soirees, greatly contributed to the general satisfaction.—*Rev. Encyc. Oct.* 1830.

6. *Petersburg Botanic Garden.*—*Louis Riedel* who has been connected as botanist to the scientific expedition of M. *Langsdorf* at Brazil, has brought from Rio-Janeiro, for the botanic garden a collection of more than a thousand living Brazilian plants, beautiful and rare, among which are many that have not before been found in any Botanic Garden in Europe. This rich acquisition, joined to the young plants which the garden of Petersburg had before obtained from seeds sent from Brazil, will be sufficient to fill a large Green-house in

which in the latitude of 68° the amateurs of Botany may form an idea of the beauty and variety of the flora of a vast country, situated between the tropics.—*Rev. Encyc. Nov.* 1830.

7. *Kingdom of Wirtemburg.*—On the first of Nov. 1826 the population of this kingdom was 1,517,770 inhabitants, of whom 1,055,132 profess the evangelical and 462,857 the Catholic worship, 9,100 are Jews, 463 menonists, and hernhuters.

In 1827 the University of Tubingen was frequented by 800 students of whom 90 were foreigners. In the same year there were in the kingdom, in 59 Gymnasia and Latin Schools 2,303 Students, in 1,400 primary protestant schools, 160,000 students, in 787 primary catholic Schools, 30,000 Students. Of new works there were published in the same year 149, public Journals 48, Le nombre des enfans naturel fut, 7,475 sur une population de 1,540,000; civil prisoners 1,084, of whom 673 were Protestants, 403 Catholics, 1 Greek, 7 Jews. 790 were men and 294 women, 1037 were condemned to more than 3 months imprisonment and 7 to death.—*Idem.*

8. *Iron Trade of Great Britain.*—(Repertory of Arts.) The whole iron made in Great Britain has been as follows :—

1740,	17,000 tons,	from	59	furnaces.
1788,	68,000 "	"	121	"
1796,	125,000 "			
1806,	250,000 "			
1820,	400,000 "			
1827,	690,000 "	"	284	"

The iron produced in 1827 was made as follows :—

South Wales,	272,000 tons,	from	90	"
Staffordshire,	216,000 "	"	95	"
Shropshire,	78,000 "	"	31	"
Yorkshire,	43,000 "	"	24	"
Scotland,	36,500 "	"	18	"
North Wales,	24,000 "	"	12	"
Derbyshire,	20,500 "	"	14	"
	690,000		284	

About $\frac{3}{10}$ths of this is used for home consumption, and the other $\frac{7}{10}$ths are exported.—*Brewster's Journal.*

9. *Russian Universities.*—The University of Petersburg which contained in 1826, 30 pupils, had in 1829, 177. The number of students in the eight governments of its arrondissements, was 10,200.

The number of pupils of the University of Moscow, which in January, 1830, celebrated the 75th anniversary of its foundation, had, during the scholastic year of 1829, 660 exclusive of 18 candidates and 38 surgeons who continued their studies in it. The total number of students in the 296 institutions of public instruction of the eleven governments of the University circuit, was 15,601. These students were divided as follows.

Number and kind of establishments.		Number of pupils.
Gymnasia,	11	1,089
District schools,	94	7,506
Parish and primary schools,	134	4,945
Boarding and private schools,	54	994*
University of Moscow,		716
Boarding school for the nobility at Moscow,		272
High school of Demidoff,		79
Total number of establishments,	296	15,602

The number of pupils in 1829 was 1,300 more than in 1828; and that of professors and masters 827, which makes about 18 pupils to one master.—*Rev. Encyc. Sept.* 1830.

10. *Destruction of Live Stock by Wolves in Russia.*—In the government of Livonia alone, the following animals were destroyed by wolves in 1823. The account is an official one.

Horses,	1,841	Goats,	2,545
Fowls,	1,243	Kids,	183
Horned cattle,	1,807	Swine,	4,190
Calves,	733	Sucking pigs,	312
Sheep,	15,182	Dogs,	703
Lambs,	726	Geese,	673

Idem.

MECHANICAL PHILOSOPHY.

1. *Voltaic electricity.*—Professor Saverio Barlocci, of Rome, in a memoir on the influence of solar light in the production of electrical phenomena, relates the following experiments:—Having decomposed a beam of light, by the solar prism, he caused the red ray, and the violet ray to fall on two disks of copper, painted black, and to each disk was adapted a copper wire. Two rings of copper sliding on two vertical rods of glass, were attached each to one of the wires, so as

* Of whom 362 are boys, and 632 girls.

to admit of their being easily brought together or separated at pleasure. He then suspended a prepared frog to the upper wire, and placed the hind feet of it on the lower wire. Thus prepared, whenever the disks were plunged, one of them into the red ray, and the other into the violet, and the extremities of the two wires were brought into contact, contractions took place in the muscles of the frog.—*Jour. des Prog. des Sciences et Med., Tom. II*, 1830.

2. *Safety of steam engines.*—The societé d'Encouragement of Paris have decided upon granting two premiums;—"One to him, who shall perfect and complete the means of safety, which have hitherto been employed or proposed, against explosions of steam engines and other boilers, or point out better ones; the other, to him, who shall invent a form, and a construction of the boiler, which will prevent or annul all danger from explosions."

Each of these premiums shall be two thousand francs, and decreed to any Frenchman, or Foreigner, who shall be deemed most worthy of it.

The method proposed must have been tested by, at least, six months' trial in a steam engine of high pressure, of ten horse power or larger, or on a boiler of equal force. The efficacy of the proposed improvement must be duly authenticated, and the inventor must renounce any intention of securing patent priviliges. The memoirs, designs, or models, reports or certificates must be sent before the first of July, 1831.—*Ann. des Mines.*

3. *Violent thunder storm in Switzerland.*—At the meeting of the Helvetic society last year at St. Gall, an account was given by M. Watt of a storm in the Canton of Basle, on the sixteenth of July, 1830.

The road which leads from Soleure to Basle by Wangen, passes over the Haunstein, on the north eastern extremity of the Jura. On the highest point of this route, the clouds collected from different quarters, and poured their contents upon the northern side of the mountain. The Hauptbach, a small brook, runs through the valley, along which the road passes, and empties into the Ergeltz, which, in turn, discharges itself into the Rhine. In a few moments these streams were transformed into enormous torrents from six to ten feet deep. The water, bearing with it wood and stones, overthrew every thing in its passage. The roads were destroyed from the top of the valley, the bridges and farms were ruined. At Waldenburg, it demolished all the houses in the lower part, and inundated those in the upper. Proceeding onward, the villages of Oberdorf and Nulerdorf were soon left a heap of ruins. On the village of Höllstein, the devastating torrent poured with all its fury;—three houses alone remained entire. The fruit trees, of this fertile valley, were destroyed. Of the bridge at the baths of Bubendorf, built of hewn stone, not a vestige remains. The farms were ravaged over the extent of five leagues. An idea of the prodigious volume of water which was condensed and precipitated on this occasion may be formed, from the fact, that at Basle, about two leagues below the embouchure of the Ergeltz, in less than an hour, the Rhine rose two feet. The smiling and fertile plain of Höllstein was left a desert. Twenty one persons perished in this disaster.

The waters, in some places, appeared to have fallen in masses. M. Watt ascribes this, and other similar phenomena, to the great thickness of the strata of clouds, brought together in the first instance by winds from different quarters. The drops formed on the upper surface in the higher regions of the atmosphere, are, by their descent through such a mass of vapor, enlarged by all the vesicles which they meet with. This produces a great condensation. A cloud is formed in the atmosphere by some particular refrigerating cause, and thus overshadowing a space below, deprives it of the sun's rays, and thus occasions a rarefaction of the air. The surrounding air, charged with vapor is precipitated into this partial vacuum, and thus occasions such an accumulation of vapor as, when suddenly condensed, forms torrents of this frightful description.—*Bib. Univ. Oct.* 1830.

4. *Decomposition of water by atmospheric electricity.*—M. Bonijol, curator of the Reading Society of Geneva, and a zealous friend of science, having constructed a variety of delicate apparatus, by which water is easily decomposed by common electricity, has succeeded in effecting it also by the electricity of the atmosphere. The atmospheric electricity is drawn off from an insulated rod by a very fine point, which communicates with the apparatus in which the decomposition is effected, by a wire whose diameter does not exceed half a millimetre. Water is thus decomposed constantly and rapidly, even when the atmosphere is moderately electric. It is only necessary that the weather be stormy.—*Ibid.*

5. *Decompositions by common electricity.*—M. Bonijol has decomposed potash and chloride of silver by placing them in tubes of glass very narrow, and passing sparks through them from a common machine, by the mere approach of two wires. When the sparks are rapidly continued from five to ten minutes, reduced silver is found in the tube filled with the chloride; and in that containing potash, the potassium is seen to take fire as it is disengaged.—*Ibid.*

6. *Heat produced by the compression of gas.*—In the June No. of the Ann. de Chimie et de Phys. Baron Thénard publishes some observations on the light which is emitted from air and from oxygen by compression. Common air, oxygen and chlorine, are the only gases which are known to emit light when compressed. Hydrogen, azote and carbonic acid, afford no such phenomena. Thénard, presuming that this difference might arise from the combustion of the oil or grease with which the piston of the compressing machine is impregnated, performed the experiment so as to avoid this source of error, by using a piston of potter's felt, well moistened with water, after having washed the tube well with potash to remove the grease. There was then no light, how forcible soever the compression of oxygen gas; but at the same time, if a piece of paper or dry wood, were attached to the end of the piston, there was a vivid inflammation in the same gas. Chlorine presented the same results. Thus no gas becomes luminous by simple compression in the pneumatic fire pumps. It was ascertained that a fragment of pine wood would not inflame in oxygen gas at the temperature of 350° cent. under atmospheric pressure. It only became of a deep brown color, but it inflamed at 252° under a pressure of 260 centimetres.

To determine the *temperature* to which compression would elevate other gases, M. Thénard used fulminating powders which exploded at different temperatures. He thus ascertained that a gas compressed as strongly as possible by hand in a glass tube, rises much beyond 205° centigrade (or 401° F.) Powders which decompose at 205° cent. explode in azote, hydrogen and carbonic acid by sudden and strong compression.—*Ibid.*

7. *The seat of taste.*—By covering the tongue with parchment, sometimes in whole, and sometimes in different parts, it has been determined by two experimenters in Paris, M. M. Guyot and Admyraula, that the end and sides of the tongue, and a small space at the root of it, together with a small surface at the anterior and superior part of the roof of the palate, are the only portions of surface in the cavity of the mouth and throat, that can distinguish taste or sapidity from mere touch. A portion of extract of aloes, placed on any other part, gives no sensation but that of touch, until the saliva carries a solution of the sapid matters to those parts of the cavity.—*Ibid.*

8. *Currents in the ocean, by Charles Rumker, Esq.*—"The waters of the Pacific being supposed higher than those of the Atlantic, I expected an easterly current on approaching Cape Horn, but I could discover none. Near the northern coasts of the Brazils and Guiana,

we experienced strong currents to the west, in conformity with Humbolt's theory of an indraft into the Caribbean Sea, occasioned by an equatorial current." Mr. R. gives a table of comparison between the ship's place by observation and that obtained by the log, with the drifts and force of the current for twenty-four hours.

9. *Sargasso Weeds.*—In the North Atlantic Ocean, coming from the South you fall in about the tropic, with the Sargasso weeds, collected in narrow lines extending in the direction in which the trade wind blows, that is E. N. E. and W. S. W., and the eye cannot see the end of them on either side of the vessel. These lines run constantly parallel to each other, and the nearer you come to the middle of the Sargasso sea, the thicker it is strewed with weeds, and the closer the lines approach to one another, being in some places but fifteen feet asunder. Home bound ships have a better opportunity of observing these lines, as they cross nearly at right angles, and can trace their continuation more conveniently on both sides, observing one line after another in rapid succession.

These weeds occupy the zone from about 20° to 35° north latitude, which may, however, differ according to the longitude in which you cross it. Towards the zone's northern extremes, the weeds are less regularly formed in lines, which may arise from their being less methodically acted upon by the trade winds that seem to occasion their order. They have been termed gulf weeds by sailors, who believed them to be driven out of the gulf by the Florida stream; nor is this opinion entirely refuted by the experience that they are rarely met with in the gulf. For the weed swimming on the surface of the Atlantic is withered, decayed, and incrutsed with salt, which proves the time it has been exposed to the sun, and is of a brownish yellow color, whilst you rarely meet with a green bunch ; that, being heavier, on account of its higher state of vegetation, swims several feet below the surface. It is true that not with certainty can any roots, thicker branches, or stems be perceived, wherewith they might have adhered to the rocks or the ground: nevertheless, as these weeds abound with animals that do not live upon the surface, but inhabit the bottom of the sea, such as crabs, shrimps, barnacles, conchilias of all descriptions, and serpents, I have no doubts that they originated in a shallow basin of water, out of which they were swept by the force of a current along the bottom, until the heavier vegetable fluid being exhausted, they rose to the surface. Moreover they are never seen near the European or African coasts, but most plentifully found about the entrance of the gulf.—*Phil. Mag. and Ann. Decem.* 1830.

10. *Arrangement of Rocks.*—Dr. K. C. Von Leonhard, professor of Mineralogy and Geology at Heidleberg, dissatisfied with the old division of rocks into Primitive, Transition and Secondary, has proposed the following, which he regards as better defined by analogies of character, better connected by reciprocal gradation, by organic remains, and by a constant, or at least a very frequent, appearance of various members of such groups.

I. Postdiluvial.
II. Diluvial.
III. Fresh water Gypsum, with coarse limestone, (grob kalk) and plastic clay.
IV. Chalk and green sand.
V. Jura and oolite limestone.
VI. Lias and Keuper.
VII. Shell limestone (muschel kalk) and variegated sandstone.
VIII. Magnesian limestone, (zechstein) and red sandstone, (tod-liegendes)
XI. Coal.
X. Transition limestone, greywacke, and clay slate.—*Jameson's Journal, Oct.* 1830.

11. *Enormous quantity of iron manufactured, and of coal consumed in Wales.* (*Foster, in Transactions of the Natural Society of Northumberland, Durham and Newcastle.*)—The quantity of iron annually manufactured in Wales, has been calculated at about 270,000 ons. Of this quantity a proportion of about three fourths is made into bars, and one fourth sold as pigs and castings. The quantity of coal required for its manufacture on the average of the whole, including that used by engines, workmen, &c. will be about 5½ tons for each ton of iron; the annual consumption of coal by the iron-works will therefore be about 1,500,000 tons. The quantity used in smelting of copper ore, imported from Cornwall, in the manufacture of tin plate, forging of iron for various purposes, and for domestic uses may be calculated at 350,000, which makes altogether the annual consumption of coal in Wales = 1,850,000 tons. The annual quantity of iron manufactured in Great Britian is 690,000 tons. From this statement it will be observed that the quantity of iron smelted in Wales, is upwards of one third of the total quantity made in Great Britain. The manufacture of the Welsh Iron is in the hands of a few extensive capitalists, and is carried on with great spirit and attention to improvement. The principal works are in the town of Merthyr, and its immediate neighborhood; and as the greatest proportion of metal produced is manufactured into bar iron, a process which in the refining,

puddling, and cementing of the metal, necessarily requires a great number [of furnaces, their appearance on approaching Merthyr, by night, from the hills with which it is surrounded, presents a scene which is probably without a parallel.—*Jameson's Jour. Oct.* 1830.

12. *Importance of the discovery of the curing of Herrings.*—The discovery of the mode of curing and barreling Herring, by an obscure individual of the name of Beukles, or Beukelzon, towards the middle of the 14th century contributed more, perhaps, than any thing else, to increase the maritime power and wealth of Holland. At a period when the prohibition of eating butcher meat during two days every week, and forty days before Easter, was universal, a supply of some sort of subsidiary food was urgently required; so that the discovery of Beukles became of the greatest consequence, not to his countrymen only, but to the whole christian world. The Emperor Charles V. being in 1550, at Biervliets, where Beukles was buried, he visited his grave and ordered a magnificent monument to be erected, to record the memory of a man who had rendered so signal a service to his country.—*Idem.*

CHEMISTRY.

1. *Quantity of carbonic acid in the atmosphere.*—An elaborate series of experimental observations to determine the changes which take place in the quantity of carbonic acid in the atmosphere, has been made by *Theodore De Saussure*, an account of which, was given in a memoir read at the Societé de Phys. et d'Hist. Nat. de Genève on the eighteenth of February, 1830. The following is the author's *Résumé.*

"The variations, which I have observed in the atmospheric carbonic acid, in the open country, are due to two principal causes:

"1st. To the changes which the soil undergoes in its moisture, which absorbs this gas, and the dryness which evolves it. 2nd. To the opposing influences of night and day, or from darkness which increases, and light which diminishes, the proportion of this gas.

"The upper strata of the atmosphere contain more carbonic acid than the lower.

"The variations of this gas from day and night are scarcely sensible in the upper strata. They appear to participate more fully in the less sudden changes of the lower strata by the general effect produced by moisture.

"The variation, occasioned by day and night, is relatively small in the streets of Geneva; but it is considerable on the adjacent lake, which presents no obstacle to the lateral circulation of the air of the country.

"A violent wind commonly increases the carbonic acid during the day, in the lower strata of the air, and destroys, in whole or in part, the increase of the gas during the night."

The author's experiments were continued during several years, the last noted, being on the third of January, 1830. They amounted to the number of two hundred and twenty five. He found in a volume of ten thousand parts of air, a minimum of about 3.06 parts, and a maximum of 5.78 parts of carbonic acid.

On the summit of the Dole, about four thousand feet above the surface of the lake, the quantity was 4.61, while, at the same time, at Chambeisy, on the plain, it was 4.74, and on another occasion it was 4.91 on the mountain and 4.46 on the plain. This difference is ascribed to the superior influence of vegetation on the plain, which decomposes the carbonic acid, and to the greater absorption of it by the streams. The greatest difference observed at the extreme heights was during a time of extraordinary humidity.—*Bib. Univ. Juin*, 1830.

2. *On the mutual action of iodic acid and morphine, or the acetate of that base; by* M. Serullas.—If iodic acid, in solution, at a common temperature, be brought into contact with a single grain of morphine, or acetate of that base, the liquid becomes of a deep red brown, and exhales a strong odor of iodine. The hundredth part of a grain of acetate of morphine, is sufficient to produce the effect very sensibly. The action is prompt when the fluid is somewhat concentrated, slower when diluted, but not less appreciable, in the lapse of a few seconds even in seven thousand parts of water.

Quinine, cinchonine, veratrine, picrotoxine, narcotine, strychnine, and brucine, subjected to the same trial, have no action on iodic acid; while the smallest quantity of morphine, or its acetate, becomes evident in the manner just mentioned. Iodic acid may therefore be regarded as an extremely sensible reagent for detecting the presence of morphine, either free or combined with acetic sulphuric, nitric or hydrochloric acid, not only isolated, but also in mixture with vegetable alkalies, provided the latter have no action on iodic acid; or, if they have any, that it does not resemble that which morphine exerts under the same circumstances.

To render more distinct the iodine set free in the experiment, we may begin by triturating with a little starch jelly, the small quantity of liquid containing the morphine, or its salts, and then add a few drops of the solution of iodic acid, which immediately develops the blue color.

This process will serve equally well for the detection of opium, for a few drops of laudanum, or of an aqueous solution of opium, mingled with starch paste, and then with a solution of iodic acid, immediately give a blue color.

In the reciprocal action of iodic acid and morphine, the former is evidently decomposed, since a large quantity of the iodine is set free.

The mixture, diluted with water, remains of a red brown, with a deposit of the same color, which, after exposure to the air, passes with the fluid to a clear yellow, from the volatilization of the iodine. The supernatant fluid, by spontaneous evaporation, yields a yellow powder of a crystalline aspect.—*Annales de Chim.*, *Fev.* 1830.

3. *Preparation of Crystallized Iodic Acid.*—The following process is given by Serullas as the best method of obtaining this acid. Make a solution of iodate of soda; heat it to ebullition during twelve or fifteen minutes with sulphuric acid in excess, (at least double the quantity necessary to saturate the soda,) and filter. The fluid, sufficiently concentrated, being left to itself in a stove at 20° to 25° cent. furnishes in a short time a crystalline mass, which is to be washed with a little water, placed on bibulous paper, and dried in a stove. When pressed, it divides into small brilliant crystals. The iodic acid thus obtained is pure; the process is easy; a portion of it, heated to redness in a tube ought to disappear entirely. If it can retain traces of iodate of soda, it should be dissolved a second time with addition of sulphuric acid and recrystallized.

Crystallized iodic acid is very soluble in water; but very sparingly in alcohol, which precipitates it from water. It undergoes no notable alteration in the air, nor does it attract moisture very sensibly; it has a peculiar odor, in which that of iodine cannot be mistaken. The author has not observed that it attacks gold, as has been said. He has ascertained that Sir H. Davy was mistaken in several points with regard to this acid, probably from the small quantity with which he experimented. The substances which Davy designates by the names of iodo-sulphuric acid, iodo-nitric acid, and iodo-phosphoric acid, and which he considers as durable acids in definite proportions, do not exist.—*Idem.*

4. *On fuming Nitric Acid*, by *M. Mitcherlich.*—The temperature of the laboratory being at —10° cent. he heated very gently in a retort placed on a sand bath, 10 to 20 lbs. of fuming nitric acid. A very long tube was adapted to the retort surrounded with chloride of calcium and snow, and joined to a receiver and a pneumatic tube. From the latter tube no gas was disengaged. In the receiver a liquid was condensed which formed two strata, which remained distinct after agitation, much like oil and water. The lightest fluid, when separated,

began to boil at 28° cent. and continued at that point till it was all evaporated. Its specific gravity was 1.455. It is decomposed in contact with water, into nitric acid, and oxide of azote; in a word, it presents all the properties of the compound of nitrous acid with nitric acid discovered by Dulong. On the contrary, the heavy fluid being heated, its boiling point rose continually from 28° to more than 126° progressively as the distillation was continued.

This liquid is of an intense red color like common fuming nitric acid. It becomes colorless when about one half is distilled off. The product is about one half of the light and one half of the heavy liquid. The specific gravity of the latter is 1.539. Common fuming nitric acid acts in the same manner.

It results from these experiments that fuming nitric acid is a solution of hypo-nitric acid in nitric acid, which however can dissolve only a certain quantity, about half of its weight, so that in distilling common fuming nitric acid, we obtain a heavy liquid, (viz. a saturated solution of nitrous acid in nitric acid,) and a lighter fluid, viz. hypo-nitric acid.—*Idem.*

5. *On the decomposition of Water, by C. Despretz.*—It has been long known that red hot iron decomposes water and disengases hydrogen gas, and that a current of this gas, removes entirely the oxygen from the oxide formed. Gay-Lussac has shewn that the decomposition and recomposition of water takes place at the same temperature. I find that zinc, nickel, cobalt and tin act like iron. The oxide of manganese is not completely reduced by hydrogen. Some pure peroxide of that metal, exposed to a current of the dry gas, in the highest heat of a good forge, left a portion of melted protoxide, of a very fine green color.—*Idem.*

6. *Decomposition of Carbonic Acid, by C. Despretz.*—Carbonic acid presents the same phenomena as water; it is brought to the condition of oxide of carbon by iron, zinc, and tin, and the oxides of these metals are reduced by the second gas.

The oxide of carbon was prepared by a mixture of oxalate of potash and sulphuric acid, and deprived of any acid which it might entangle by an alkaline solution.—*Idem.*

7. *On crystallizable Acetic Acid, by C. Despretz.*—The process by which crystallized acetic acid is prepared, is kept a secret. After many trials I succeeded in obtaining very fine specimens by heating a mixture in atomic proportions of melted and dried acetate of lead and boiled sulphuric acid, (203.4 parts of the former, and 61.4 of the

second.) The anhydrous acetates ought necessarily to furnish the same result as the acetate of lead.—*Idem.*

8. *Asparagin.—Chevreul and Serullas* made a report on the monography of the asparagin of *Plisson and Henri,* pharmaceutists. The authors obtained asparagin from the roots of the marsh-mallow by the following process. Having stripped the dry root of its epidermis, they subjected it to repeated infusions in warm water, and obtained, by boiling and concentration, large octohedral crystals, which they purified by a second crystallization. A kilogramme of the root of marsh-mallow gives 20 grammes of pure asparagin. This substance is colorless, inodorous, and as transparent as diamonds. The crystals have the taste of aspartic acid, (acidity apart.) Asparagin is soluble in water, insoluble in alcohol and ether; calcined to redness in contact with air, it disappears entirely and gives all the products of animal matter. Hence, according to the results of Plisson and Henri, asparagin contains much azote. Its composition may be represented by 2 proportion of ammonia, 1 of cyanogen, 3 of bi-carbonated hydrogen, and 4 of carbonic acid.

The action of water, of alkalies, and of acids upon asparagin is very remarkable. It occasions, in every instance, the same phenomenon of transformation, namely, ammonia and aspartic acid, variously combined with the reagents employed. The acids, especially the sulphuric, very readily produces aspartic acid. The authors impute these changes to electro-chemical forces, the nature of which is determined by these various agents, and this suggested the idea of making experiments with other animal matters, such as gelatine, albumen, &c. The results confirmed their prepossessions, and they think that a great number of neutral azotized animal matters may be arranged, in this respect, under the same law. The employment of lime in preventing the exhalation of gases depends on the same principle, by changing into non-deleterious bodies those which result from dead carcases left to themselves. The authors conclude also that the products of putrid fermentation are much more numerous than is commonly thought.—*Rev. Encyc. Oct.* 1830.

9. *Decomposition of metallic salts, by Carlo Matteuci.*—Having charged an electric column of thirty pairs, the author plunged the platina wires, which were in connection with the poles, into a solution of marine salt, and immediately from both extremities there was an evolution of gas. But when the wires were transferred to a solution of sulphate of copper, he was surprised to find that no hydrogen was disengaged from the negative wire, which became covered neverthe-

less with metallic copper, while oxygen continued to flow from the positive wire. He varied the experiment by trying other metallic solutions: silver and lead, and some others, presented the same phenomena, except that the silver and lead were transported in the metallic state, while in other cases only the oxide was deposited.

We must, in these cases, suppose, either that the hydrogen combines with the metal, or that the metal, separated in the state of oxide, is reduced by the hydrogen, which forms water by its combination with the oxygen of the oxide. The latter supposition only is admissible. To assure himself of its truth, he took a pile of two pairs, incapable of decomposing water slightly saline. A solution of nitrate of silver, of much easier decomposition than water, was easily decomposed, and it was observed that there was at first deposited, not metallic silver, as was common, but an olive coat of oxide of silver. Thus it is proved that the disengagement of hydrogen at the negative pole ceases, only because this gas is employed in reducing the oxides separated from their combination with acids, by the electric agent.

Thus it appears that hydrogen, in its nascent state, is capable of decomposing oxides, a property it does not commonly possess, except at elevated temperatures.

In pursuing the investigation, the author took a pile of two pairs, charged with water very slightly saline, and which could not, of course, decompose even acidulated water. He placed the platina wires of this pile in a solution of chloride of copper, and observed, in the course of time, that the negative wire was acquiring a coating of metallic copper, while from the positive wire bubbles of gas were rising. Having changed the platina conductor for one of silver, the latter acquired a yellow coating, which soon became violet, and which led him to suspect the presence of chloride of silver. The experiment was repeated with iodide of zinc and of iron; and scarcely were the platina wires plunged into these solutions, when the iodine appeared, distinctly, at the positive pole, and the metal was reduced at the negative pole.

From these experiments the author thinks it may with certainty be affirmed, that these combinations, even when dissolved in water, do not change their nature, and are not converted, as chemists have often imagined, into hydro-chlorates, hydriodates, &c., of oxides.—Forli, 10 Sep. 1830.—*Bib. Univ. Oct.* 1830.

10. *The Black Sea.*—Dr. P. C. Hepites, of Odessa, has analyzed the water of this sea, with the following results: Spec. grav. 1011. 10,000 parts of the water being evaporated at a low heat, left 65 parts of a yellowish residue, which consisted of

Hydrochlorate of soda - - - - -	35
Do. lime - - - - -	3
Sulphate of magnesia - - - - -	10
Do. lime - - - - -	2
Vegetable matter analogous to gelatine - -	8
Loss and a little iodine - - - - -	7

—*Idem.*

11. *Charring of wood at low temperatures.*—Mr. Charles May, chemist, of Ampthill, has sent me some specimens of wood converted into nearly perfect charcoal, at a very low but long continued heat. The pieces, he informs, are part of the bottom of a tub, which held about 130 gallons, and which had been in use in his laboratory about three years and a half, and almost constantly worked for boiling a weak solution of common salt, generally with an open steam pipe, and sometimes, though rarely, with a coil: the temperature was seldom higher than 216° or 220°, and the vessel was lined with tin rolled into sheets about one-sixteenth of an inch thick, and nailed to the inside; the joints, however, were not so good as to prevent the liquid from getting between the metal and the wood. Mr. May states also, that he had long since remarked, that on making extracts with steam of very moderate pressure, all the apparent effects of burning might be produced, but that he was not prepared to find so complete a carbonization of wood by steam; the vessel was made partly of fir, and partly of ash, the former of which was most perfectly reduced to the state of charcoal. R. P.—*Phil. Mag. and Ann. Nov.* 1830.

12. *Limits to vaporization.*—A paper on the above named subject, by Mr. Faraday, was published in the Philosophical Transactions for the year 1826: when the experiments therein mentioned were published, others relating to the same subject were arranged, but which required great length of time for the development of their results. After a lapse of four years the experiments were examined, and the results are now stated. In September, 1826, several stoppered bottles were made perfectly clean, and several wide tubes close at one extremity, so as to form smaller vessels, capable of being placed within the bottles, were prepared. Then selected substances were put into the tubes, and solutions of other selected substances into the bottles; the tubes were placed in the bottles, so that nothing could pass from one substance to the other, except by way of evaporation. The stoppers were introduced, the bottles tied over carefully, and put away in a dark safe cupboard, where, except for an occasional examination, they have been left for nearly four years, during which time such

portions of the substances as could vaporize, have been free to act and produce accumulation of their specific effects.

In this way it was found that neither sulphate of soda, nor muriate of barytes, were volatilized; the same was the case with solution of nitrate of silver and chloride of sodium; diluted sulphuric acid and common salt; solution of potash and arsenious acid in pieces and powder; diluted sulphuric acid and muriate of ammonia: solution of persulphate of iron and ferrocyanate of potash in crystals; solution of potash and fragments of calomel; solution of iodide of potash and chloride of lead; solution of muriate of lime and crystals of carbonate of soda; solution of per-sulphate of copper and crystals of ferro-cyanate of potash,—from these experiments it would appear, Mr. Faraday observes, "that there is no reason to believe that water or its vapors confer volatility, even in the slightest degree, upon those substances which alone have their limits of vaporization at temperatures above ordinary occurrence, and that consequently natural evaporation can produce no effects of this kind on the atmosphere."

From other experiments, Mr. Faraday concludes that "nitrate of ammonia, corrosive sublimate, oxalic acid, and perhaps oxalate of ammonia, are substances which evolve vapor at common temperatures." (Journal of the Royal Institution, October, 1830.)—*Phil. Mag. and Ann. Nov.* 1830.

13. *Composition of gunpowder.*—Dr. Ure has analyzed various samples of gunpowder, and the following are the results of his investigation:

Waltham Abbey—nitre, 74.5; charcoal, 14.4; sulphur, 10.; water, 1.1

Hall, Dartford—nitre, 76.2; charcoal, 14.; sulphur, 9.0; water, .5; loss, .3

Pigou & Wilkes—nitre, 77.4; charcoal, 13.5; sulphur, 8.5; water, .6

Curtis & Harvey—nitre, 76.7; charcoal, 12.5; sulphur, 9.; water, 1.1; loss, .7

Battle gunpowder—nitre, 77.; charcoal, 13.5; sulphur, 8.; water, .8; loss, .7

"The process," observes Dr. Ure, "most commonly practised in the analysis of gunpowder seems to be tolerably exact. The nitre is first separated by hot distilled water, evaporated and weighed. A minute loss of salts may be counted on from its known volatility, with boiling water. I have evaporated always on a steam bath. It is probable that a amall proportion of the lighter and looser constituents of gunpowder, the carbon, flies off in the operations of corning and dusting. Hence analysis may show a small deficit of charcoal below the synthetic proportions originally mixed. The residuum of charcoal and sulphur left on the double filter paper, being well dried by the heat of ordinary steam, is estimated as usual by the difference of weights of the inner and outer papers. This residuum is cleared off into a platina capsule with a tooth-brush, and digested in a dilute solution of potash at a boiling temperature. Three parts of potash are fully sufficient to dissolve out one of the sulphur. When the above solution is thrown on a filter and washed first with a very dilute solution of potash boiling hot, then with boiling water, and afterwards dried, the carbon will remain; the weight of which deducted from that of the powder will show the amount of sulphur."

Dr. Ure says that he has tried other and more direct modes of estimating the sulphur, but with little satisfaction; such as dissolving it by means of hot oil of turpentine, its conversion into sulphuric acid by the use of nitric acid and chlorine, &c.

"If we acquire" says Dr. Ure, "how the maximum gaseous volume is to be produced from the chemical reaction of the elements of nitre on charcoal and sulphur, we shall find it to be by the generation of carbonic oxide and sulphurous acid, with the disengagement of nitrogen. This will lead us to the following proportions of these constituents:—

1 prime equiv.		of nitre	102	75.00 per cent.
1	do	sulphur	16	11.77
3	do	charcoal	18	13.23
			136	100.00

The (acid of the) nitre contains five primes of oxygen, of which three, combining with the three of charcoal will furnish three of carbonic acid gas, while the remaining two will convert the one prime of sulphur into sulphurous acid gas. The single prime of nitrogen is, in this view disengaged alone.

The gaseous volume, on this supposition, evolved from 136 grains of gunpowder, equivalent in bulk to 75 grains of water, or three-tenths of a cubic inch, will be, at the atmospheric temperature, as follows:

	Grains.	Cubic inches.
Carbonic oxide,	42	141.6
Sulpurous acid,	32	47.2
Nitrogen,	14	47.4

Being an expansion of one volume into 787.3. But as the temperature of the gases at the instant of their combustive formation must be incandescent, this volume may be safely estimated at three times the above amount, or considerably upwards of two thousand times the bulk of the explosive solid."—*Idem.*

14. *Purple powder of Cassius.*—M. Buison states that in preparing this substance, he found that the solution of gold always contains the same muriate, though it may be mixed with more or less acid; but he observes, that the solution of tin, even when well prepared, contains two different muriates and it is upon their co-existence, within certain limits, that he conceives the goodness of the solution to be owing. The experiments upon which this opinion are founded are the following.

1st. The solution of proto-muriate of tin, as neutral as possible when mixed with a solution of gold, gives a maroon, brown, blue, green, or metallic precipitate, according to its concentration and proportion, but the color is never purple.

2d. Pure per-muriate of tin, whether acid or not, produces no change in the same solution of gold, whatever be the proportions employed.

3d. A mixture of one part of proto-muriate nearly neutral, and two parts of per-muriate of tin, with one part of muriate of gold, instantly occasions a fine purple color. Founded on these facts, M. Buison gives the following process for obtaining the purple powder:

4th. Dissolve about 15 grains of granulated tin, in muriatic acid, either with or without heat, taking care that the solution is neutral.

5th. Prepare a solution of per-muriate of tin by dissolving about 30 grains of tin in a sufficient quantity of aqua-regia, composed of three parts of nitric acid, and one part of muriatic acid; taking care that the solution is neutral, and free from proto-muriate which is determined by its giving no precipitate with a solution of gold.

6th. To prepare the solution of gold, dissolve about 108 grains of gold in aqua-regia, composed of one part of nitric acid and six parts of muriatic acid; the solution should be nearly or quite neutral.

Dilute the solution of gold, so that a pint of it contains about 15 grains of the metal. Pour in the per-muriate, till the required tint is produced, remembering that the proto-muriate causes a brown, and the per-muriate a violet color, and intermediate proportions give a red. Wash the precipitate as quickly as possible, that no action may take place between the salts of tin and the precipitate, which alters its color. The purple powder of a fine tint yielded by analysis;

Metallic Gold,	28.5
Peroxide of tin,	65.9
Chlorine,	5.3
	99.6
Loss,	4
	100.0

(Jour. de Pharmacie, October, 1830.)—*Idem.*

15. *Arsenic in Sea Salt.*—The presence of arsenic in sea salt has already been observed in that found in commerce; and MM. Latour de Frie and Lefrançois, students in pharmacy, have lately detected it in a salt used in the canton of Sézanne, in the department de la Marne. It appears to have occasioned serious accidents; and was submitted to examination, which showed that the salts contained a quarter of a grain of deutoxide of arsenic in an ounce. The authors purchased salts in various parts of Paris, but did not detect arsenic in any one sample.—*Ibid.*

16. *On chloride of Silver;* by *M Cavalier.*—(Jour. de Pharmacie)—The color produced in chloride of silver by the action of light, has long been known, and a similar change is apparently produced by some chemical reagents; but whether the alterations are identical is a question which M. Cavalier says he does not pretend to decide. He then states a method by which the violet chloride of silver may be procured without the agency of light. Dissolve some recently prepared and perfectly white chloride of silver in ammonia, and pass a current of chlorine gas through it, and the same phenomena as occur when the gas is passed through mere solution of ammonia will be presented; such as slight detonation on the arrival of each bubble to the surface, abundant white vapors, increase of temperature, the disengagement of azotic gas, &c. Afterwards, the solution becomes turbid, and soon a greyish precipitate is observed; at length it assumes a well marked violet color: this color occurs when the ammonia is completely decomposed by the chlorine.

What is the nature of this new substance? Is it a smaller or greater quantity of chlorine which has modified the properties of the chloride; or is it identical with the white chloride: and is the color acquired, merely the result of a different molecular arrangement?

The following experiments are in favor of the latter opinion.

If the violet chloride be dissolved in ammonia, nitric acid precipitates it white. Take 20 grains of violet and 20 grains of white chloride, put each into a glass, and with them diluted sulphuric acid and a piece of zinc, stirring the chloride with the latter so as to keep it suspended; the chlorides are both decomposed by the hydrogen evolved, and metallic silver is obtained, and from each chloride the same quantity, viz. 15 grains.

According to these experiments, the new substance cannot be regarded either as sub-chloride or a deuto-chloride; every circumstance seems to prove that the color is produced merely by a different molecular arrangement. In this case, it remains to be explained what is the body which forces the chloride to acquire a different physical property. The heat produced during the operation has certainly nothing to do with it, for the experiment succeeds equally when the vessel is placed in a freezing mixture.—*Idem*, *Dec.* 1830.

17. *Preparation of Bromine and its Hydrate.*—(Ann. der Phys.) —The mother liquors containing bromine are to be evaporated to a fourth of their volume in iron pans, and then left for several days; in which time the larger part of the chloride of calcium crystallizes. The supernatant liquor, being diluted with water, is to be mixed with sulphuric acid as long as a precipitate is formed. The liquid portion being separated, and the solid residue pressed, all the fluid is to be mingled and evaporated to dryness, and then redissolved, that a certain quantity of sulphate of lime may be removed. On acting upon the solution by sulphuric acid and peroxide of manganese, and then distilling, bromine is obtained.—*Idem.*

18. *Hydrate of Bromine.*—This compound is easily formed at a temperature of from 39° to 43° Fahrenheit, by making the vapor of bromine pass into a tube moistened with water; in about a quarter of an hour the tube is filled with solid hydrate.—(Ann. de Phys. XIV. 485. Roy. Inst. Journ. April 1830.)—*Idem.*

19. *New process for obtaining Lithia.*—M. Quesneville jun. gives the following as his method of separating Lithia. "I take one part of levigated Triphane, and mix it accurately with two parts of powdered litharge: I put the mixture into a crucible, and expose it to a white heat. In about a quarter of an hour the mass is perfectly fluid; I then cool it and powder it finely: I afterwards act upon it by nitric acid, the silica separates in a very divided state; I precipitate all the nitrate of lead by sulphuric acid, and evaporate to dryness to expel all the nitric acid. I afterwards treat it with water, and precipitate the alumina and other metallic oxides by ammonia, and then add carbonate of ammonia to precipitate the lime and magnesia; the solution is then filtered and evaporated to dryness. The mixture is to be strongly calcined to expel all the ammoniacal salts; this operation must not be performed in a platina crucible, as it would be acted upon; I use a porcelain one. The calcined residue is to be treated with water, and all the sulphuric acid precipitated by barytes; the filtered liquor when evaporated gives pure lithia."—(Jour. de Pharmacie April, 1830.)—*Idem.*

20. *On Powdering Phosphorus.*—M. Casaseca remarks, that the method of pulverizing phosphorus, mentioned by all chemical authors,

is that of agitation for some time in water, in a well corked bottle; but, he observes, the powder obtained by this method is very imperfect; whereas if alcohol at 36° be used instead of water, a powder of the utmost fineness is produced, which has a crystalline appearance, and on agitating the liquid in the sun, the bottle appears to be entirely filled with a light brilliant powder.—*Idem.*

21. *Preparation of Sugar from Starch.—M. Heinrich* says, that from one to two parts of sulphuric acid for each 100 parts of potato starch is sufficient, if the heat applied be a few degrees above 212 Fahr.; and also, that then two or three hours are sufficient to give crystallizable sugar. He applies the heat in wooden vessels by means of steam.—(Roy. Institution Jour. June, 1830.)—*Idem.*

22. *Sulphate of Potash and Copper.*—When equal quantities of Sulphate of potash and sulphate of copper are mixed, a particularly bright, green precipitate is gradually formed, which Vogel considered as a subsalt. Having been analysed by Brunner, it appears to consist of

Oxide of Copper, - - - - - -	39.23
Potash, - - - - - - - -	12.12
Sulphuric acid, - - - - - -	39.70
Water, - - - - - - - -	8.94
	100.00

Idem.

23. *On improvement in black writing ink; by John Bostoch*, M. D. F. R. S., &c.—(Transactions of the Society of Arts of London.)—The changes, which tend the most to impair the value of ink, are its moulding, the separation of the black matter from the fluid, and its loss of color,—the black first changing to brown, and at length disappearing. The author considers the gallic acid to be the only part of the solution of the gall nut, which is essentially concerned in the production of permanent black ink, and that the tan, the mucilage, and the extractive matter are the causes of its deterioration. The moulding is considered as arising from the mucilage, and the precipitation to be chiefly occasioned by the extractive matter. The tan, it is conjectured, forms a triple compound, in the first instance, with gallic acid and the iron; and that in consequence of the decomposition of the tan, this compound is afterwards destroyed.

The practical conclusions, says the author, that I think myself warranted in drawing from these experiments, are as follows:—In order to procure an ink, which may be little disposed either to mould or to deposit its contents, and which, at the same time, may possess a deep black color, not liable to fade, the galls should be macerated for some hours in hot water, and the fluid be filtered; it should then be exposed, for about sixteen days, to a warm atmosphere, when any mould that may have been produced must be removed. A solution of sulphate of iron must be employed, which has also been exposed for some time to the atmosphere, and which, consequently, contains a certain quantity of the red oxide of iron diffused through it. I should recommend the infusion of galls to be made of considerably greater strength, than is generally directed; and I believe that an ink, formed in this manner, will not necessarily require the addition of any mucilaginous substance to render it of a proper consistence.

I have only farther to add, that one of the best substances for diluting ink, if it be, in the first instance, too thick for use, or afterwards becomes so by evaporation, is a strong decoction of coffee, which appears, in no respect, to promote the decomposition of the ink, while it improves its color, and gives it an additional lustre.—*Jameson's Journal, Oct.* 1830.

MEDICAL CHEMISTRY.

1. *Tincture of Iodine.**—Dr. Joerg, professor of obstetrics at Leipsic, has formed a society for the purpose of determining the properties of some of the most useful and active medicaments by an actual trial of them by the members themselves. The following is the result with regard to iodine.

"The positive effect of the tincture of iodine consists in an excitement of the whole alimentary canal; it appears to act upon the parieties of the intestines like a good concentrated salivary and pancreated fluid. Hence, with persons in health there is a saline taste in the mouth; an augmentation of salinary secretion; thus, increase of appetite, sensible motion of the intestines, slight pains, evacuation of wind and fecal matters. But this excitement is transmitted also to the brain, as happens with most substances which increase the activity of the intestinal canal; producing heaviness and pain in the head, felt sometimes in one place and sometimes in another. Iodine increases no less the afflux of blood to the tracheal artery and the lungs, and places those organs in a condition approaching to phlogosis, or, actually inflames them. This irritation seems to extend to the internal membrane of the nose, since the mucous secretion is increased as well as the bronchial. As iodine acts so energetically upon the digestive tube, it must affect equally the genito-urinary apparatus when admin-

* R. Iodine, 48 grains; pure alcohol, one ounce. Agitate until the iodine is entirely dissolved. Ten drops of this tincture contains one grain of iodine.

istered in large doses; and several members of the society have experienced these secondary effects in the most decided manner.

Further, since iodine acts not only on the internal surface of the intestines, but also on that of the connected parts which open into the digestive tube, upon the glands of the mouth and the stomach, it must also increase the saliva, the gastric juice, the pancreatic fluid, the bile, &c. It must therefore modify, extensively, the process of assimilation and nutrition, if employed in suitable doses and under appropriate circumstances. Now, if iodine possesses a character of this kind; if, as has been said, it stimulates the activity of various glands, we certainly cannot refuse it the power of resolving inveterate swellings and indurations of the glands.

But what physician would restrain the use of a medicine so powerful, to the treatment, singly, of goitre? may we not expect from iodine the best effects in diseases of the abdominal viscera, occasioned by the weakness of the digestive tube, to the stagnation of the blood in the vessels of those parts, in scrophula, and other similar affections. It promises to afford eminent service in those cases in which the vegetative process of the animal economy is in a suffering state, from a diminution of vital energy. The employment, however, of this medicine demands the greatest precaution; if administered in excess, it may easily give rise to inflammation or a morbid relaxation of the parts. Two, three, six or eight drops of the tincture will be the ordinary dose, which should be repeated only once in twenty four or forty eight hours, and taken each time in a little water. F. J. Riester.

Jour. des progres des sciences Medicales, 1830, *Tom.* II.

(Additional selections from foreign Journals, by Mr. C. U. Shepard.)

1. *Pinguite, a new argillaceous mineral.*—(A. Breithaupt, Schweigger's Jahrb.; 1829, H. 3, S. 303.) This mineral is not unlike green iron-earth; but its greasy lustre or fracture, entirely distinguishes it from that substance. Compact. Hardness =1. Specific gravity =2.315. When heated in a glass tube, it gives off much moisture. It comes from the mine of New Beschert Glück, in the Saxon Erzgeberg; and occurs in a gangue of Heavy-Spar engaged in gneiss.—(*Jahrbuch für Mineralogie, &c.* 1830. *S.* 86.)

2. *Prunnerite.*—The violet blue mineral found along with apophyllite in the island of Hestoe, one of the Faroës, and hitherto arranged as a variety of cuboidal calcareous spar, has been, by Esmark, on account of its form and large proportion of silica, put forth as a new species, which he names Prunnerite, in honor of Prunner, the naturalist, of Cagliari, in Sardinia.—(*Edin. New Phil. Journ.* 1830, *p.* 382.)

3. *New analysis of Brewsterite.*—Mr. Connell has repeated the analysis of this mineral, which Retzius, according to Berzelius, found to contain

Silica,	- -	57.285
Alumina,	- -	17.011
Soda, Lime,	- -	7.764
Water,	- - -	17.872
		99.932

Mr. Connell's specimens were from Strontian, and gave

Silica,	- -	53.666	
Alumina,	- -	17.492	
Strontia,	- -	8.325	15.074
Baryta,	- - -	6.749	
Lime,	- -	1.346	
Oxide of iron,	- -	.292	
Water,	- -	12.584	
		100.454	

Its formula may be expressed by $\frac{Sr}{B} S^2 + 4 A S^3 + 6Aq$; or, if we suppose the proportion of the strontia and baryta to be 2 atoms of the former to 1 of the latter, the constitution will then be, 2 atoms bisilicate of strontia +1 atom bisilicate of baryta +12 atoms tersilicate of alumina +6 atoms of water.—(*Idem. Jan.* 1831, p. 35.)

4. *Polarizing Rocks.*—The first observations concerning the magnetic polarity of rocks were made by Baron Humboldt in 1796. He noticed it in a serpentine rock on the Haidberg, near Celle, in the country of Baireuth. It was afterwards observed in many other rocks, such as hornblende-slate, porphyry, trachyte, basalt, &c.* It is apparently confined to mountains containing magnetic iron-stone, although the quantity of this admixture in itself does not limit the intensity of the property; as indeed it shows itself with different purely magnetic iron stones in the greatest variety of degrees of strength, and there are some of these which show no magneto-polar action. Neither is there any regularity in the position of the axes either in one and the same mass of rock in general, or a fixed correspondence, in the position of these axes, with the direction of the strata of the rocks.

* For the discovery of Humboldt and those connected with it, see the *Intelligenz Blatt Algemeine Literaturzeitung*, 1796 and 1797. *Neues Bergmann's Jour.* I, pp. 257 and 542. Gren's *Neues Jour. d. Chem. u. Phys.* IV. V. Moll's *Jahr. d. Berg. u. Hutten Kunde*, III, p. 301. V. Moll's *Neues Jahr. d. B. u. H.* II, p. 403. Gilbert's *Annalen*, neue Folge, XIV. Heft I, p. 89. Goldfusz and Bischoi's *Phisik. Statist. Beschreiburg d. Fichtelgeberges*, I, p. 139, and *ibid.* altere Reihe, XVIII, p. 297.

Bergmeister Schulze, of Duren, in an excursion in the Eifel, a region of graywacke and basalt, observed from the top of the Nürburg mountain, (a basaltic cone two thousand Prussian feet above the level of the Rhine) on an elevation in an eastern direction, something resembling the ruins of a building. Instead of ruins, however, he found it to be two small rocks, about three feet distant from each other in their diagonals, about six feet high, with bases not far from three feet square: one of them was six feet long and three feet broad; the other was a little shorter, but broader. Both rocks were stratified, with a dip of twelve hours and parallel to the basaltic range on which they reposed. On presenting a magnetic needle to them, it was subject to sudden and violent changes. The circumference of one of them attracted the north pole through half its extent, but repelled it for the remainder. The manner in which the needle was affected by the other rock may be understood by drawing a line lengthwise through the center of the upper plane of the rock, and another crosswise through the same plane, so that the point of contact shall occupy the center of the plane: the north pole of the needle was attracted at the extremities of the longer line, while the opposite pole was attracted at the extremities of the shorter one.

M. Reuss, of Berlin, counsellor of mines, observed the same property in a mountain of dark, grayish, black basalt, free from magnetic iron stone, in the Mittelgeberg, (lordship of Schröchenstein.) The mountain, one thousand eight hundred feet high, is covered with wood to its summit, and precipitous on all sides. Its polarity is so great, that the needle at its eastern foot was moved 40°, and at the summit itself, 90° W. At the western foot of the rock, the contrary was the fact; but the polarity is shown not only in the whole mass of the rock, but likewise in the larger detached pieces, and even in the smallest fragments;—the north point of the needle being at one end distinctly attracted, and at the opposite end as distinctly repelled.

These observations, detailed in the *Jahrbuch der Chem. u. Phys.* of Dr. Schweigger, render it possible that the magnetic results obtained by Prof. Hitchcock upon the mica-slate mountain of Canaan, in Connecticut, may be connected with the polarity of rocks; and not dependent upon a mass of native iron, as supposed.*

5. *Nitrous Atmosphere of Tirhoot.*—Tirhoot is one of the principal districts in India for the manufacture of saltpetre; the soil is every where abundantly impregnated with this substance, and it floats in the atmosphere in such quantities, that, during the rains and cold weather, it is attracted from thence by the lime on the damp walls of houses, and

* See Vol. XIV, p. 223, of this Journal.

fixes there in the shape of long, downy crystals of exceeding delicacy. From damp spots it may be brushed off every two or three days almost in basketsful. In consequence of all this, the ground, even in hot weather, is so damp, that it is extremely difficult either to get earth of sufficient tenacity to make bricks (the country being quite destitute of stones), or, when made, to find a spot sufficiently solid to sustain the weight of a house. Even with the greatest care the ground at last yields, and the saltpetre corrodes the best of the bricks to such a degree, that the whole house gradually sinks several inches below its original level. Houses built of inferior materials, of course suffer much more; one, of which the inner foundations were of unburnt bricks, absolutely fell down whilst I was at Mullye, and the family in it escaped almost by miracle. My own house, which was not much better, sunk so much, and the walls were at bottom so evidently giving way, that I was compelled, with extreme expense and inconvenience, to pull down the whole inner walls, and build them afresh in a more secure manner. From the same cause, a new magazine which government directed to be built, with an arched roof of brick-work, was, when complete, found so very unsafe, that it was necessary to demolish it entirely, and rebuild it on a new plan, with a roof of tiles. In such a soil, it will easily be concluded that swamps and lagoons prevail very much, of course, mostly during the rains, and till the sun gathers power in the hot weather; and, in fact, what has been above so much insisted on, as to the two contrary aspects of the country with respect to vegetation, may, by a conversion of terms, be equally applied to the water on its surface. In the cold and dry weather it is comparatively scanty, in the rains it is superabundant; and as the rivers in this district are frequently found to change their situations, so, through a long course of time, it has resulted that hollow beds, being deserted by their streams, become transformed into what, during the rains, assume the appearance of extensive lakes, but in dry weather degenerate into mere muddy swamps, overgrown with a profusion of rank, aquatic vegetations, particularly the gigantic leaves of the Lotus, and swarming with every tribe of loathsome, cold-blooded animals. Some of these lakes, during the height of the rains, communicate with their original streams, and thus undergo a temporary purification; but others receive no fresh supply except from the clouds, and of course their condition is by much the worse. Some of the conversions of a river-bed into a lake, have occurred in the memory of the present inhabitants, or at least within one descent from their ancestors.—*Tytler, on the Climate of Mullye, in Trans. Med. & Phys. Soc. of Calcutta*, vol. iv.

APPENDIX.

An account of a large Electro-Magnet, made for the Laboratory of Yale College;* by JOSEPH HENRY and DR. TEN EYCK.

(Extract of a letter to Prof. Silliman, accompanying the Magnet.)

THE magnet is constructed on precisely the same principles as that described in the last number of the Journal. It weighs 59½ lbs. avoirdupois, (exclusive of the copper wire which surrounds it,) and

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* This magnet is now arranged in its frame, in the laboratory of Yale College. Being myself out of town when the instrument arrived, the necessary experiments and fixtures were satisfactorily made by Mr. C. U. Shepard, (Chem. Assis.) and Dr. Titus W. Powers, of Albany, who was so obliging as to bring the magnet to New Haven. There has not been time (as the magnet came just as this No. was finishing) to do any thing more than make a few trials, which have however fully substantiated the statements of Prof. Henry.† He has the honor of having constructed by far, the most powerful magnets that have ever been known, and his last, weighing, armature and all, but 82¼ lbs., sustains over a ton. It is eight times more powerful than any magnet hitherto known in Europe, and between six and seven times more powerful than the great magnet in Philadelphia. We understand that the experiments described in the last No. of this Journal, (except those ascribed to Dr. Ten Eyck) were devised by Professor Henry alone, who (except forging the iron) constructed the magnet with his own hand. The plan of the frame, and the fixtures, and the drawing in the last No., were done by Dr. Ten Eyck. In the Yale College magnet, the plan was drawn by Professor Henry, and the iron forged under his direction. The length of the wires being agreed upon, the winding was done by Dr. Ten Eyck, and the experiments were mutually performed.—*Ed.*

† It may be worth while to state a single experiment, which I made with a view to learn the chemical effects of this instrument. As its magnetic flow was so powerful, I had strong hopes of being able to accomplish the decomposition of water by its means. My experiment, however, which was made as follows, proved unsuccessful. The battery being immersed, to the extremities of the magnet were applied two broad, polished plates of iron, terminating in flattened wires, which were united with the wires of the ordinary apparatus for decomposing water, and the contact heightened by the use of cups of mercury: not the slightest decomposition was, however, observable. Aware, that had any chemical effect been produced, this arrangement could have decided nothing, (except perhaps from the degree of energy in the decomposition) as respects the point whether simple magnetism is adequate to decompose water, since it might under these circumstances be attributed to the electricity from the battery, I had determined in a second experiment, had the first proved successful, to have interrupted the galvanic flow by a non-conductor; in which case, had the decomposition ensued, pure magnetism might have been considered as the decomposing agent. But as my preliminary experiment was unsuccessful, I proceeded no farther; I hope, however, to resume the research hereafter, under more favorable circumstances. C. U. SHEPARD.

was formed from a bar of Swede's iron three inches square and thirty inches long. Before bending the bar into the shape of a horse-shoe, it was flattened on the edges, so as to form an octagonal prism, having a perimeter of $10\frac{3}{4}$ inches. The other dimensions of the magnet, as measured before winding it with wire, are as follows:—perpendicular height of the exterior arch of the horse-shoe $11\frac{3}{4}$ inches—around the outside from one pole to the other $29\frac{9}{10}$ inches—internal distance between the poles $3\frac{1}{2}$ inches.

The armature or lifter is formed from a piece of iron from the same bar, not flattened on the edges; it is nearly 3 inches square, $9\frac{1}{2}$ inches long, and weighs 23 lbs. The upper surface is made perfectly flat, except about an inch in the middle where the angles are rounded off so as to form a groove, into which the upper part of a strong iron stirrup, surrounding the armature, fits somewhat loosely. The weight to be supported is fastened to the lower part of the stirrup, and by means of the groove is made to bear directly on the center of the armature.

For the purpose of suspending the magnet, a piece of round iron with an eye on one end, is firmly screwed into the crown of the arch and is attached to the cross beam of a frame, similar to that figured in the last number of the Journal.

The magnet is wound with 26 strands of copper bell wire, covered with cotton thread 31 feet long; about 18 inches of the ends are left projecting, so that only 28 feet actually surround the iron; the aggregate length of the coils is therefore 728 feet. Each strand is wound on a little less than an inch; in the middle of the horse-shoe it forms three thicknesses of wire, and on the ends or near the poles it is wound so as to form six thicknesses.

Two small galvanic batteries are soldered to the wires of the magnet, one on each side of the supporting frame, in such a manner as to cause the poles to be instantaneously reversed, by merely dipping the batteries alternately into acid. To render these as compact as possible, they are formed of concentric copper cylinders with cylinders of zinc plates interposed and so united as to form but one galvanic pair. Each of these batteries presents to the action of the acid, measuring both surfaces of the plate, $4\frac{7}{9}$ square feet—they are 12 inches high and about 5 inches in diameter.

In experimenting with this magnet, a battery containing $\frac{2}{5}$ of a square foot of zinc surface was first attached to the wires; with this the magnet could not be made to support more than 500 lbs. Another battery was then substituted for the above, containing about three times the same quantity of zinc surface; with this, at the first instant of immersion, the magnet sustained 1600 lbs.; after the acid was removed, it continued to support, for a few minutes, 450 lbs.; and in one experiment, three days after the battery had been excited, more than 150 lbs. were added to the armature* before it fell. It was evident from these experiments, that this magnet required a considerably larger quantity of zinc surface in proportion to its weight, to magnetize it to saturation, than that described in the former paper. Accordingly the two batteries, before mentioned as containing $4\frac{7}{9}$ square feet, were prepared. With one of them, at the first immersion, the magnet readily supported 2000 lbs. A sliding weight was then attached to the bar; the battery was suffered to become perfectly dry, and on immersing it again, the magnet supported 2063 lbs. The effect of a larger battery was not tried.

To test its power of inducing magnetism on soft iron, two pieces of round iron $1\frac{1}{4}$ inches in diameter and 12 inches long, were interposed between the extremities of the magnet and the armature—with this arrangement, when one of the batteries was immersed, the pieces of iron became so powerfully magnetic as to support 155 lbs.

To exhibit the effects produced by instantaneously reversing the poles, the armature was loaded with 56 lbs. which added to its own weight made 89 lbs.; one of the batteries was then dipped into the acid and immediately withdrawn, when the weight of course continued to adhere to the magnet; the other battery was then suddenly immersed, when the poles were changed so instantaneously, that the weight did not fall. That the poles were actually reversed in this experiment, was clearly shown by a change in the position of a large needle placed at a small distance from the side of one extremity of the horse-shoe.

P. S. Last autumn, I commenced a series of observations on the magnetic intensity of the earth at Albany, and intend to begin a new series next month; the apparatus used was that sent by Capt. Sabine to Prof. Renwick, and was mentioned in the Journal, Vol. XVII, p. 145. I have constructed a similar apparatus for myself, and intend to pay considerable attention to the subject.

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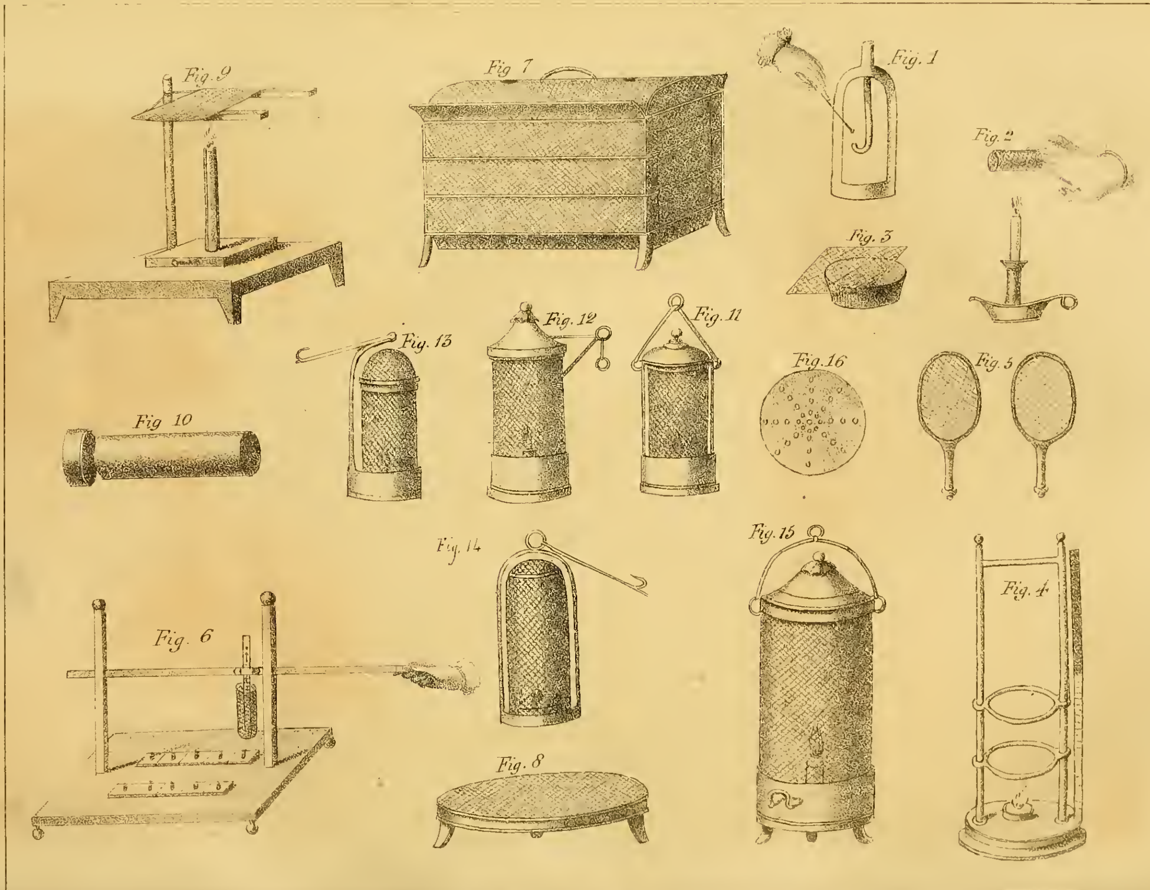
* The armature of 23 lbs. applied when the battery is immersed, only for an inch and an instant, remains, day after day, without falling, although the galvanic coils are perfectly dry.—*Ed.*

Drawing of the Crotalus, &c.

Mr. Eaton, having seen the last proof of the drawing of his supposed fossil crotalus or arundo, requests that the following remarks may be added.

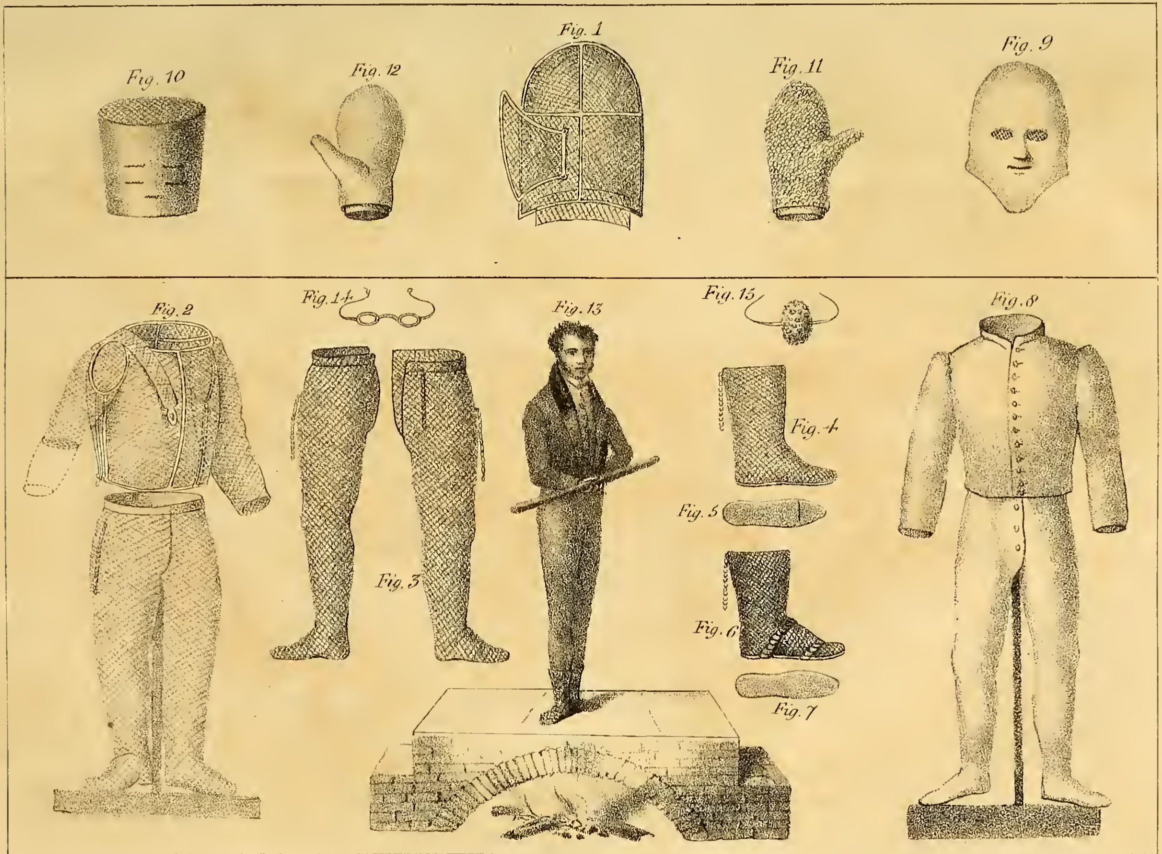
The figure is *stiffly* accurate, as the original appears when magnified; though it is the natural size. I preferred this to having it shaded; as it affords a better opportunity for accurate comparison. It is engraved, at my request, in a stiff (and rather artificial) manner, which the drawing would not warrant. A. E.

Pl. I.



Pendleton's Lithog.y Boston.

Pl. II



Pendleton's Lithog. Boston

Fig 2

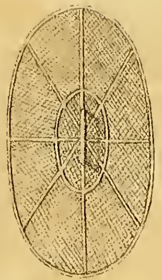


Fig. 5

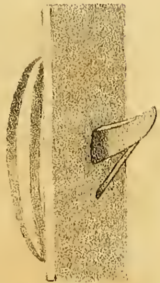


Fig. 1

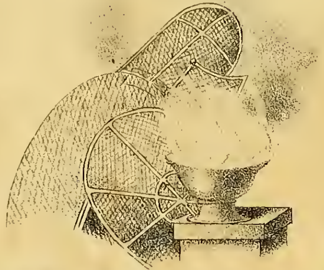
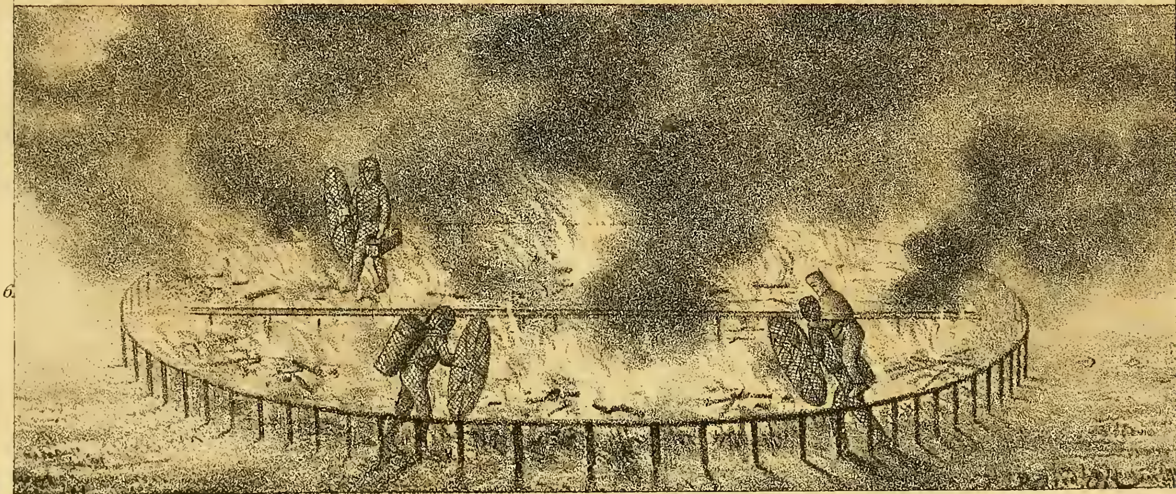


Fig. 4

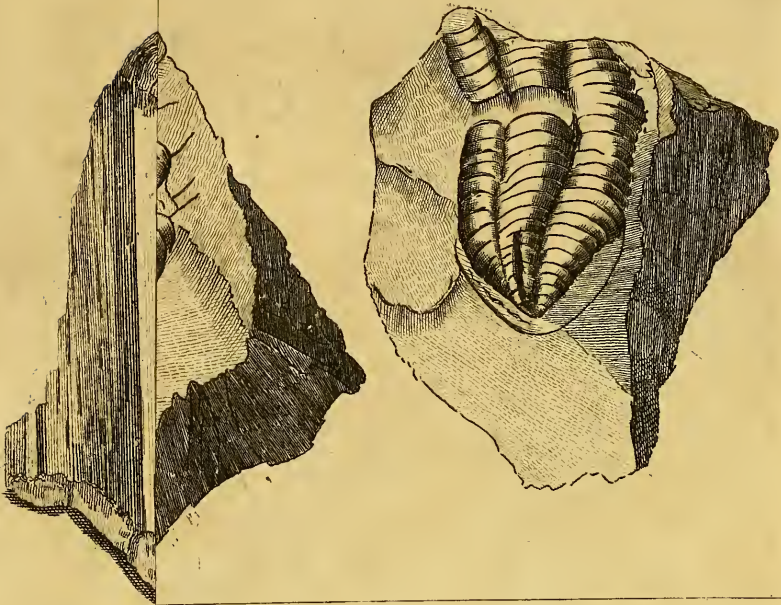
Fig. 3

Fig. 6.

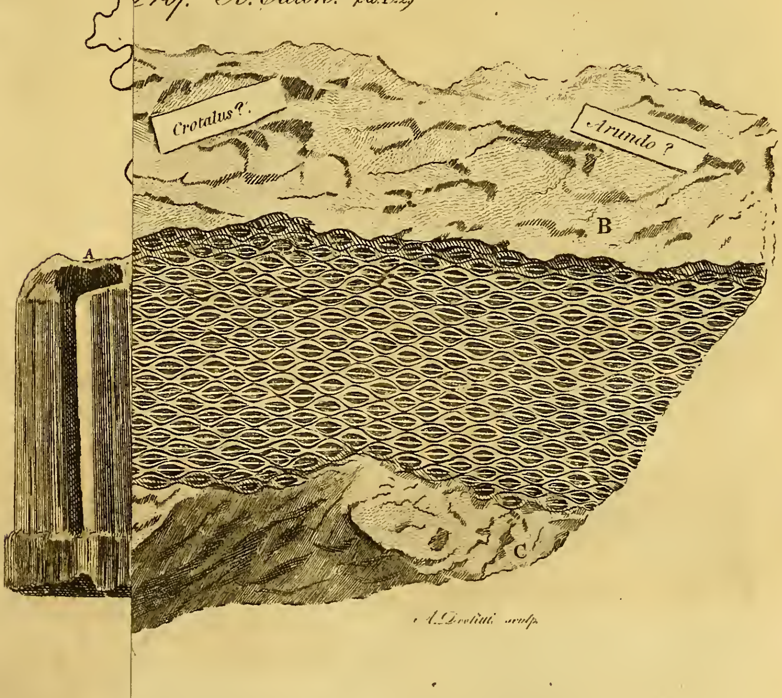


Pendleton's Lithog.y Boston.

Fig. 6. (b)



Prof. A. Eaton. pa. 122.



A. Doolittle sculp.

Transition Rocks of the Cataraqui.

See page 74.

Fig. 1.

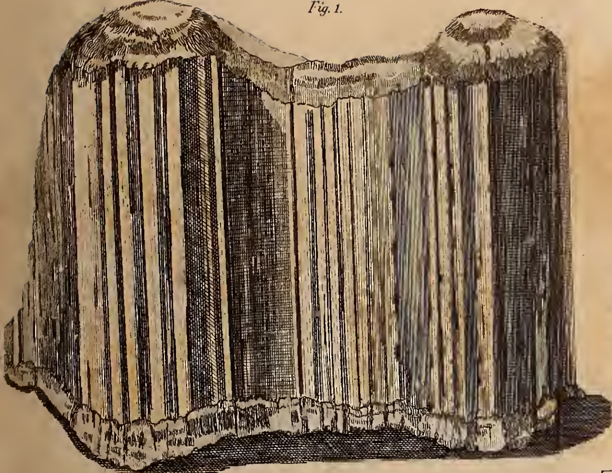


Fig. 3.

Fig. 6. (a)

Fig. 6. (b)

Fig. 2.

Fig. 4.

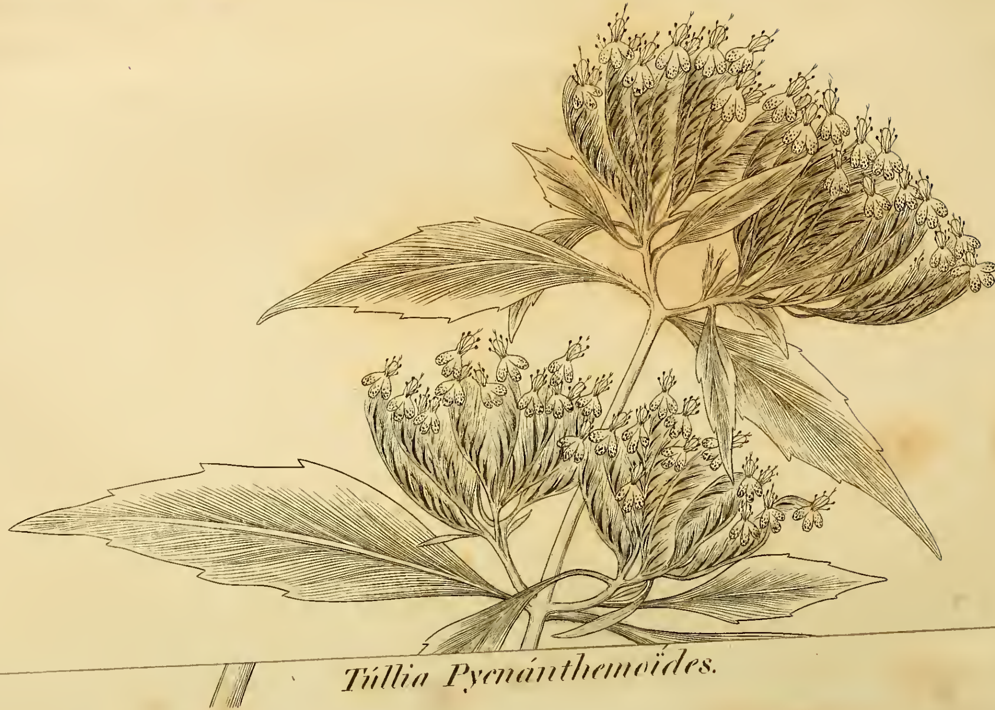
Fig. 5.

Fig. 4.

Organic relic. (Prof. A. Eaton. pa. 122)

Miss S. Tee del.

A. Doolittle sculp



Túllia Pycnánthemoïdes.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*Remarks on the supposed tides, and periodical rise and fall of the North American Lakes; by* Major HENRY WHITING, U. S. Army.

IN the article "on the supposed tides in the great North American Lakes," communicated by Gen. H. A. S. Dearborn, (Vol. XVI. No. 1. April 1829,) it is stated that Gov. Cass had been requested to cause observations to be made, during his stay at Green Bay, on the changes of elevation in the waters at that place. In the year 1828, while there on public duties, he did so, during a course of more than six weeks. The following table is the result, presenting a series of observations of such extent and minuteness, as to determine as satisfactorily, perhaps, as the case admits, the character of the phenomenon in question. A cask, without heads, was fixed in the Fox river, just within its mouth, with a rod, graduated with inches, placed perpendicularly in the center. The cask was perforated so as to admit the water freely, while the rod, at the same time, was protected from such fluctuations of the surface as the wind might cause.

Table of observations on the rise and fall of the Lake at Green Bay, made by Gov. Cass in 1828.

Day of the month.	Time of the day.	Course of the wind.	Strength of the wind.	Height of the water.
July 15, 1828.	9	N.	Moderate.	9
"	Noon.	"	"	8
"	4	"	"	5½
"	7½	"	"	11
16,	6½	W.	Light.	10
"	8	"	"	10½
"	1	"	"	6
"	4	"	"	6
"	7½	"	"	6½

Túllia Pycnánthemoïdes.

Day of the month.	Time of the day.	Course of the wind.	Strength of the wind.	Height of the water.
17,	6	S. W.	Light.	6
"	8	"	"	8¼
"	Noon.	"	"	6
"	4	"	"	5½
"	7½	"	"	8
18,	6	"	"	1
"	8	"	"	4
"	Noon.	"	Strong.	7
"	4	"	"	4
"	7½	"	"	7
19,	6	W. of S. W.	Light.	7
"	8	"	"	5
"	9	"	"	11
"	Noon.	"	"	5½
"	4	"	"	7
"	7½	"	"	6½
20,	8	No wind.	None.	6
"	Noon.	N. W.	Light.	8
"	4	"	"	10
"	7½	"	"	5½
21,	8	S. W.	"	9½
"	2	"	"	10
"	4	"	"	
"	7½	N.	Violent storm.	18
22,	7	S. W.	Light.	10
"	Noon.	"	"	0
"	4	"	"	14
"	7½	"	"	11
23,	8	"	Moderate.	3½
"	Noon.	"	"	1½
"	4	"	"	11½
"	7½	"	"	11
24,	8	N. E.	Light.	9
"	Noon.	"	"	8
"	4	"	"	14
"	7½	"	"	10
25,	8	S. W.	Moderate.	5½
"	Noon.	"	"	5½
"	4	"	"	9½
"	7½	"	"	12½
26,	8	"	Light.	11
"	Noon.	"	"	10
"	4	"	"	8½
"	7½	"	"	7

Day of the month.	Time of the day.	Course of the wind.	Strength of the wind.	Height of the water.
27,	8	W.	Light.	10½
"	Noon.	"	"	6
"	4	"	"	2
"	7½	"	"	12
28,	8	N.	Fresh.	4
"	Noon.	"	"	11
"	4	"	"	2
"	7½	"	"	8⅛
29,	8	S. W.	Light.	11
"	Noon.	"	"	6½
"	4	"	"	4
"	7½	"	"	8
30,	8	N. W.	"	9
"	Noon.	"	"	5
"	4	"	"	9
31,	8	S. W.	"	7
"	Noon.	"	"	7
"	4	"	"	8
"	7½	"	"	7½
Aug. 1,	8	N.	"	13
"	Noon.	"	"	9
"	4	"	"	7
"	7½	"	"	8
2,	8	N. E.	"	7
"	Noon.	"	"	11
"	4	"	"	1
"	7½	"	"	11
3,	8	S. W.	"	4
"	Noon.	"	"	10
"	4	"	"	7
"	7½	"	"	9
"	9	"	"	7
4,	8	N. W.	"	7
"	Noon.	"	"	8
"	4	"	"	12
"	7½	"	"	5
5,	8	S. W.	"	6
"	Noon.	"	"	6½
"	4	"	"	12
"	7½	"	"	7
6,	8	"	"	6
"	Noon.	"	"	9
"	4	"	"	8
"	7½	"	"	10

Day of the month.	Time of the day.	Course of the wind.	Strength of the wind.	Height of the water.
Aug. 7,	8	S. W.	Light.	8
"	Noon.	"	"	6
"	7½	"	"	9
8,	Noon.	N.	"	6
"	4	"	"	7
"	7½	"	"	7
9,	8	S. W.	Strong.	2
"	Noon.	"	"	0
"	4	"	"	13
"	7½	"	"	6
10,	8	N. E.	Pretty fresh.	13
"	Noon.	"	"	9
"	4	"	"	10
"	7½	"	"	16
11,	8	"	Light.	10
"	Noon.	"	"	8
"	4	"	"	6
"	7½	"	"	7
12,	8	S. W.	"	8
"	Noon.	"	"	2
"	4	"	"	5
"	7½	"	"	9
13,	8	"	"	10
"	Noon.	"	"	5
"	4	"	"	4½
"	7½	"	"	9
14	8	"	Moderate.	4
"	Noon.	"	"	5
"	4	"	"	6
"	7½	"	"	5
15,	8	N.	Fresh.	10
"	Noon.	"	"	6
"	4	"	"	3
"	7½	"	"	4
16,	8	S. W.	Light.	6
"	Noon.	"	"	6
"	4	"	"	5
"	7½	"	"	7
17,	8	N.	"	7
"	Noon.	"	"	3
"	4	"	"	11
"	7½	"	"	7
18,	8	N. W.	"	4
"	Noon.	"	"	7

Day of the month.	Time of the day.	Course of the wind.	Strength of the wind.	Height of the water.
Aug. 18,	4	N. W.	Light.	10
"	7½	"	"	5
19,	8	S.	Fresh.	4
"	Noon.	"	"	8
"	8	"	"	8
"	7½	"	"	5
20,	8	S. W.	Light.	5
"	Noon.	"	"	7
"	4	"	"	11
"	7½	"	"	8
21,	8	N.	"	6
"	Noon.	"	"	8
"	4	"	"	10
"	7½	"	"	9
22,	8	No wind.	"	10
"	Noon.	"	"	7
"	4	"	"	11
"	7½	"	"	14
23,	8	S. W.	"	8
"	Noon.	"	"	7
"	4	"	"	11
"	7½	"	"	7
24,	8	"	Moderate.	8
"	Noon.	"	"	9
"	4	"	"	7
"	7½	"	"	8
25,	8	"	Light.	10
"	Noon.	"	"	4
"	4	"	"	11
"	7½	"	"	13
26,	8	Northerly.	"	12
"	Noon.	"	"	8
"	4	"	"	10
"	7½	"	"	7
27,	8	"	"	12
"	Noon.	"	"	8
"	4	"	"	9
"	7½	"	"	14
28,	8	"	"	12
29,	Noon.	"	"	13

An examination of the foregoing table will probably satisfy most minds, that planetary influence has little or nothing to do with the changes of elevation in the waters there noted. The oceanic tides, though somewhat modified in their height and recurrence by winds, and other terrestrial agents, are, nevertheless, so regular in their flux and reflux, as to show a constant and inseparable connexion with the movements of the moon and sun. We presume the only question here to be, whether the apparent tides in the lakes exhibit any characteristics of a similar connexion; that there is a frequent rise and fall in the level of the lake waters is beyond dispute. And it is as certain, that these fluctuations, in some places, appear to be as independent of atmospheric, as of lunar control. But, while we are unable to refer them to one cause, it does not follow that they must be assigned to the other. Gov. Cass did not annex to his observations any note of the "moon's southings" at the time. If there were the remotest probability that such a reference could be useful, it might still be done. But the utter discrepancy between all lunations and the ebbs and floods noted down in his table, renders such a task supererogatory. If the table be examined throughout, there will probably not be found an instance, where the time of high water tallies with the moon's southing, admitting the usual retardation. Even if there were several such instances, they ought to be regarded as fortuitous coincidences, as nothing but a prevailing concurrence would authorize us to link them together as cause and effect.

It may be well to draw a few facts from the table, to show the irregularity and caprice of the times of high water. To avoid any appearance of making partial selections, we begin at the first dates. July 15th, it was high water at ½ past 7, P. M. the 16th, at ½ past 8, P. M. the 17th, at 8, A. M. the 18th, at noon, and again at ½ past 7, P. M. the 19th, at 9, A. M. the 20th, at 4, P. M. the 21st, at ½ past 7, P. M. the 22d, at 4, P. M. the 23d, at 4, P. M. the 24th, at 4, P. M. the 25th, at ½ past 7, P. M. Making allowance for a part of the night, during which no observations were made, the intervals would still appear without the slightest accordance with planetary attraction. They rather, so far as these instances go, evince something like a diurnal variation, arising from some local atmospheric habitude. Upon reference, however, to the course of the wind, as stated to have prevailed during those days, we do not find any such alternations of its currents, as would sustain such an opinion.

It will be seen, as we have before remarked, that the changes of elevation are independent of the course of the winds; that the fluctuations continue, notwithstanding the winds remain the same. Gov. Cass suggests a reason why the Fox River should fall, even while the wind blows strongly up the bay and into its mouth. If a northerly wind prevail for some days, as it often does, down Lake Michigan, although it would, for a time, heap up the waters at the head of Green Bay (which runs nearly parallel with the lake,) while propelling a still greater mass towards the head of the lake, yet, the consequent depression of the level at the mouth of the bay, would soon cause a refluence of the accumulation at its head, even against the strength of the wind. This accounts for the contrariety of wind and current during a long storm; but it does not appear to apply to the diurnal, and even hourly, ebbs and floods which almost constantly succeed each other, whether the wind be blowing or not. A conjecture of some plausibility is suggested by inspecting the general course of the winds, as they are noted down in the table. Their prevailing course is up or down the bay, whose direction is about S. S. W. This would naturally have a tendency to roll the surface of the waters into waves, not very unlike those of the lunar tide, excepting their more frequent succession. These waves, whether refluent, or moving before the wind, in passing through the sinuous channel of the embouchure of Fox River, would be compressed into an increased elevation, and may be supposed to exhibit such intervals of fluctuation, as have been so long noticed at that place.

In speculating on the supposed tides of the North American Lakes, it has been natural to regard the head of Green Bay as the point where they would show themselves in the greatest fullness. The course of planetary attraction, operating on a line from east to west, would begin at the eastern part of Gloucester Bay in Lake Huron, and moving over this lake to the Straits of Mackina, and thence across the foot of Lake Michigan and up Green Bay, would traverse a space of from four hundred and fifty to five hundred miles. The configuration of the coasts too, through which the line passes, would appear to lend much extraneous aid, to give whatever wave might be formed an undue elevation; as, after crossing Lake Huron, it would be compressed into the tunnel, or rather triangular form of that part of the Lake which terminates at Mackina, causing a convolution, which would naturally send it through the straits into Lake Michigan with added height and impetuosity. Again, when the wave, after traversing the foot of Lake Michigan, still somewhat preserved in its artificial elevation, by a chain of islands that run almost the whole breadth of this transit, enters Green Bay, the same tendency to accumulation must prevail throughout the ascent of that deep arm of the Lake. The extent of Lake Superior is not equal in length to the course here described, and that lake, excepting the projection of Keewuna Point, presents but few littoral features which would have any sensible influence on the elevation of a tide-wave.

But it must be borne in mind, in reference to this subject, that the planetary attraction, on reaching the eastern point of these lakes, having brought with it no "wave," has there to begin with an initial force, and that it must pass over a considerable portion of the water before its operation can be felt. We cannot say at what distance from the eastern shore this point of sensible effect would be found; but, if Lake Huron were an isolated lake, we should probably look for no lift of the surface, from this cause, even at the western side. The tide-wave, therefore, when it arrives at the Straits of Mackina, is, notwithstanding the favoring approximation of the two shores, probably nearly or quite insensible. It is well known that, although currents and counter currents have been long noticed in these straits, no one has ever regarded them as possessing any of the characteristics of a lunar tide. Even the fact stated by Charlevoix, and to which Mr. Schoolcraft alludes in his travels, of his boat floating one way while the wind blew the reverse, may be satisfactorily explained. A continuous and strong wind prevailing either way through the straits, will propel so much water out of one lake into the other, as to destroy the equilibration of surface; when the refluent tendency of the accumulated mass will produce a counter current, though the wind may remain unchanged and unabated. Hence Charlevoix's boat may have been "carried against a head wind."

If then it be probable that there is no sensible tide at the Straits of Mackina, Lake Michigan, including Green Bay, must be considered as deriving little or no assistance, in forming its tide-wave, from the sister lake. That it would exhibit this phenomenon, if it stood alone, few would be inclined to believe, notwithstanding all auxiliary circumstances, of the chain of islands, and the tunnel form of the bay. Indeed, Lake Michigan, though favorable for the increase of a wave sent into it from Lake Huron, yet, from its comparative shallowness and diminutive breadth, seems unfavorable to the formation of one on its own bosom.

It is not to be assumed that planetary influences are wholly inoperative on the lake waters. They undoubtedly have their due effect. But that effect is probably nearly or quite insensible. If a calm could be supposed to prevail on the lakes of a sufficient continuance to allow these influences to act without disturbance from other causes, nice observations, at different points, would doubtless detect a small lunar tide. But such a halcyon lapse of time is improbable, if not impossible. And as long as shifting winds, or even breezes, are continually varying the surface of the waters, they will so interfere with these delicate tumefactions caused by the moon, as wholly to disguise or overpower them.

Reasoning from our knowledge of the great inland waters of the other hemisphere, we should take it for granted, that the North American Lakes have no sensible tide. The Caspian, Black and Baltic seas, are said to have none; and even the Mediterranean is indebted to the sharpsightedness of modern times, for the development of such a phenomenon on her wide spread bosom.

As General Dearborn has thrown out a hint respecting the supposed tide in Lake Superior, I have obtained a communication from H. R. Schoolcraft, Esq. on that subject. His long residence at the foot of that lake, combined with his enlightened powers of observation, and habitual use of them in the furtherance of scientific objects, give much weight to his opinions. Gov. Cass, whose opportunities have been great, not only to see himself, but to collect the opinions of others, is satisfied that there is no sensible lunar tides on the lakes.

"DETROIT, January 19th, 1831.

Maj. HENRY WHITING.—*Dear Sir*,—The idea of the existence of a tide in our lakes, caused by lunar attraction, appears to have originated in those changes in the level of the waters, which are produced by atmospheric phenomena. These changes were observed at a very early day, and they have continued to be observed, by travellers and by the resident population, down to our own times. The attention you formerly bestowed upon the subject, induces me to hope that you will resume your observations, and give the result of them to the public, in such a form as may enable others to judge of these phenomena, and the particulars wherein they differ—if, as I believe, they do indeed differ, from the ordinary, and from any known appearances of oceanic tide. I know not that your own observations will go the length of these conclusions, or that the conclusions themselves are based on remarks, which can be fully brought to mind. But I will endeavor to put you in possession of some facts bearing on the subject.

During a residence of nine years on the straits of St. Mary, near the foot of Lake Superior, I have remarked that the waters of those straits, and of Lake Superior, are particularly exposed to the influence of winds, which, for the greater portion of time, prevail either up or down the lake and the straits, thus subjecting them to an influence in the direction in which they are susceptible of being most affected by currents of wind. The effects are, a swelling in the waters at the point opposite to that at which the force is put in motion; and a recession of the waters whenever this force is abstracted. The rise and fall thus produced, have much of the appearance of a tide. The waters often overflow the banks; and they may recede, and again overflow the same portions of shore, twice, or oftener, during the same day.

Owing to counter currents of air, either in the higher or lower strata of the atmosphere, or to positive changes in the current of the wind itself, the results are varied, and the periods of submersion and recession rendered longer or shorter. Sometimes the water will react against the wind; sometimes it will continue to rise, when the wind itself has apparently (that is at the spot of observation) died away. Sometimes there will be little rise or fall, during the twenty-four hours. And it is only during a calm, and that continued long enough, and in itself perfect enough, to leave the waters subject only to the operation of these ordinary laws, that an apparently level and equable surface is preserved in the lake.

But it is these variations in the *time*, the *height* of water, and the *number* of the changes in any *given time*, that (without any reference to atmospheric phenomena) afford, to my mind, the most conclusive evidence that the changes in the diurnal or periodical level of the water, are separate and distinct, in their causes, from lunar tides.

The appearances of a tide rising against the wind, noticed by Capt. Dearborn at the head of the military mill-race at the Sault St. Marie, admit of explanation on the principle of a reaction of the body of water, confined in that portion of the strait (about ten miles) situated between the head of the race (which is also the head of the falls) and lake Superior.

Very respectfully, your obedient servant,

HENRY R. SCHOOLCRAFT."

Before these desultory remarks are closed, it may not be inappropriate to notice what General Dearborn terms "the periodical increase and diminution of the whole volume of water on the lakes." It is the popular tradition on these lakes, that there has been a rise and fall of the water once in every fourteen years. The New York canal commissioners, I believe, state it to be about once in eleven years. It is now a matter of record, that in 1814 and 15, the St. Clair and Detroit rivers were unusually high; that the foundations of houses, and much land that had long been under dry cultivation, were submerged. These buildings had been erected many years before, and of course under a belief that they were aloof from all but extraordinary and temporary inundations. No observations appear to have been made on the progress of the elevation, whether it were gradual or abrupt, or whether there were any preceding seasons of a character to produce it. The general impression seemed to be that the rise had been gradual, in accordance with the popular notion, that the waters rise seven years, and subside through the same period.

In 1820, or about that time, the rivers had resumed their usual level. Several wharves were built in Detroit between that year and 1828, at a height, as it was supposed, sufficiently above the general level, for all purposes of convenience and safety. At the latter date, the rivers had again attained the elevation of 1815, and remained so until 1830, with only such occasional depressions as might be caused by strong winds, being generally nearly upon a level with the wharves. In this instance, like that of the foregoing, no observations appear to have been made previous to the rise, either on the character of the seasons, or the rapidity with which it reached its maximum.

The rivers continued at this unusual height until January, 1831, when, in the course of eight or ten days, they subsided three or four feet; and they have now maintained that minimum level for about six weeks. Two hydraulic works which had been established in connexion with the river the last season, were left, by this subsidence, above high water mark, and their source-pipes have been extended many yards towards the channel, in order to reach a new supply.

In conversations with several of the intelligent old inhabitants of Detroit and its vicinity, it has been ascertained that there was a corresponding rise in the water about 1800. A road, running along the bank of the river near the town, was then nearly submerged, as it has been twice since.

Such are the simple facts and traditions relative to this phenomenon of the lakes. Being on this station in 1815, I witnessed the elevation at that time, and the subsequent depression. I was again there just before the rise in 1828, and have marked the continued elevation since that time, until the recent subsidence. There is not the same certainty as it respects the elevation of 1800; but there is no reason to doubt the concurring testimony of two or three respectable affirmers to the fact. The condition of the road—a great thoroughfare—alluded to, is a familiar and striking criterion, and likely to make an impression. There is no tradition, that we know, reaching farther back, excepting what may be inferred from the general belief of the old settlers, that the rise and fall is periodical as before stated.

As far as these facts go, they certainly favor the popular theory. but it rests on these facts alone. In every other point of view, it is improbable and seemingly absurd. There does not appear to have been any observations made on the character of the seasons immediately preceding and accompanying the elevation of the waters. We are therefore in the dark as to such causes as copious rains and abundant snows.

Abrupt and very considerable changes in the level of the Detroit river are frequently observed. Within twelve hours there will sometimes be a difference of two or three feet. But this may be satisfactorily accounted for. The Detroit river forms something like the arc of a circle, the two ends resting on Lake St. Clair and Lake Erie, whose courses continue the curve. A strong west or south-west wind drives back the waters of Lake St. Clair, thus diminishing the usual supply discharged into the river, and drives forward the waters of Lake Erie, thus lessening the volume and accelerating the current at the mouth of the river. On the contrary, an easterly wind, driving down from Lake St. Clair an increased volume of water, and heaping it up equally at the outlet in Lake Erie, causes an unusual elevation.

The sudden depression of the waters this winter, (1830–31,) before alluded to, is fresh in the recollection of every one, and if any obvious causes had preceded it, many would doubtless have observed them. It was observed that a strong westerly wind prevailed not long before. This would account for a temporary depression, upon the principles already explained, but for a temporary one only, as, even if Lake Erie were depressed many feet below its usual level, it is evident that the Detroit river would maintain its habitual height, provided the supply above continued the same; and, in the present instance, that supply would of course return, the moment the westerly wind subsided, or the refluent tendency of the accumulated waters of the lake should overcome the resistance of that wind.

Mr. Schoolcraft has incidentally remarked, that it would appear natural for all the lakes to subside in a degree during the winter months. Evaporation and other wastes go on as during the summer months, though with diminished effects, while the ice and snow withhold from the tributary streams all the moisture of the earth's surface, and leave their channels almost dry. This opinion, so well founded in natural causes, is partly sustained by facts. It has been often observed that the ice, connected with the shore, is generally, before it breaks up or dissolves, found depressed below its first level. But this effect was not so sensible in the winters of 1828–9 and 1829–30, as to be noticed at Detroit.

From the foregoing remarks, the conclusion may be drawn, that there has been a periodical elevation of the upper lakes once in about fourteen years; or, that its recurrence has been sufficiently precise, to authorize the popular belief of its regularity. But we are constrained to suppose, although destitute of the light of all observations on the subject, that they must have been caused by unusually abundant rains and snows, and that this abundance has been in fortuitous coincidence with certain cycles of time; for, improbable as this may be, it is less so, than that nature should have departed from her ordinary course.

Since closing the foregoing remarks, I have been favored with the following letter from Gov. Cass, which expresses his opinion fully on the subject, and forms a valuable commentary on it.

"Detroit, March 24th, 1831.

Sir—In the conversation we had respecting the existence of tides in the lakes of this region, I referred to a series of observations, made by myself at Green Bay, in August and September, 1828, with a view to determine this long disputed question. This paper I now enclose to you, to dispose of as you think proper.* The place of observation was upon the Fox River, about three miles above its mouth, and two miles below the point, where the current ceases to be perceptible. A cask was securely placed near the bank, and a graduated rod fixed in it. The cask was sufficiently open to show the rise and fall of the water, without being affected by the ripples on the surface, occasioned by the wind. It was my intention to record the state of the water at regular intervals, and this, as you will perceive, was generally done. But sometimes circumstances intervened to withdraw my own attention, or that of others from this duty, to

* See the Table, page 205.

whom the task of observation was entrusted. Full confidence may however be placed in these memoranda.

The slightest inspection will satisfy you, that the changes in the elevation of the water are entirely too variable to be traced to any regular permanent cause ; and that consequently there is no perceptible tide at Green Bay, which is the result of observation. And such it appears to me is the result of calculation, when the laws, which regulate solar and lunar attraction, and the limited sphere of their operation, are taken into view. And the conclusion is fortified by analogy ; for in the Baltic, the Black Sea, and the Caspian, each much larger than either of our lakes, there are no tides, or none worthy of observation. The opinion however has long prevailed, and been frequently advanced, that the ebb and flow of the water, which are constantly observed upon the shores of the North American lakes, are tides, governed by the same laws as the tides of the ocean ; and Green Bay has been often referred to as a place affording the most distinct proof of this phenomenon ; and particularly as the rise and fall of the water do not always appear to depend upon the direction of the wind. A glance at the features of the bay and lake, and at their relative position, will probably enable us to account for this prevailing error, without calling in question the veracity or judgment of preceding observers, or resorting to causes for the explanation of the difficulty, which have obviously no connexion with it.

Lake Michigan is about three hundred miles in length, and about fifty in breadth. Near its northern extremity, it is joined by Green Bay, which is in fact a deep indentation of the lake, nearly parallel with it in its course, and extending perhaps eighty miles into the country. A northerly wind blows up the bay and lake ; and as the former is comparatively small, it will much sooner feel the full effect of the wind than the latter. The water will be driven from the mouth of the bay towards the head, until it attains its maximum elevation ; and in the mean time, the operation of the same cause will propel the water of Lake Michigan towards Chicago. There will consequently be a depression at the mouth of the bay, where the water will continue to ebb, after it has risen to its full height in the upper part of the bay. For the wind, it will be recollected, is still sweeping up Lake Michigan, and driving the water before it. It is obvious that in this state of things a reaction must take place in Green Bay, and that the water will begin to flow towards the mouth, to supply the deficiency, occasioned by the transfer of a part of the contents of

Lake Michigan, from the northern to the southern extremity; and this too, while the duration and intensity of the wind remain the same. At the head of the bay, the phenomenon will thus be exhibited, of the recession of water in the face of a strong current of wind. This occurrence has no doubt led to the opinion already referred to, and the same appearances will be exhibited, though in a less striking degree, upon the shores of all the lakes. A slight variation in the force, or direction of the wind, will occasion a change in the elevation of the water, seeking at all times to attain a level; and alternations of ebbing and flowing will thus be exhibited, aided no doubt by the conformation of the coast, not easily reconcilable to the actual state of the wind. Very respectfully your obedient servant,

L. Cass.

Major Henry Whiting, U. S. A.

Art. II.—*A Notice of the Salt Springs of Moutiers, in the Tarentaise, (Alps) and of a peculiar method of evaporation; extracted from the Travels of* R. Bakewell, Esq.: Vol. II. p. 220: London.

Introductory Remarks.—By permission of the author, we insert the following extract, presuming that the method of evaporation here described may be advantageously adopted in this country, especially in the case of springs whose impregnation is weak. We are aware that methods, depending on the same principle, have been adopted in this country, but we are not informed that any of them have been permanently successful.

The springs that supply the salt works at Moutiers, rise at the bottom of a nearly perpendicular rock of limestone, situated on the south side of a deep valley or gorge, through which the Doron runs, before it joins the Isere. The distance from the springs to the salt works is about a mile; the water runs in an open canal, made for the purpose, but is received in a reservoir in its passage, where it deposits part of its ocherous contents. Formerly the canal was continued to Conflans, a distance of sixteen miles, where part of the water was evaporated.

The water rises from the rock with considerable force, and emits much gas, which is principally carbonic acid, with a mixture of sulphuretted hydrogen ; it has an acidulous and slightly saline taste. These springs rise at the end of long passages, that have been excavated in the rock. I broke off a piece of the rock in contact with the water ; it is a black imperfectly crystalline limestone, coated with a thick ocherous incrustation. From the position of this rock, and its connection with those on the other side the gorge, I have no doubt that the spring rises from the lowest limestone in this part of the Alps, where it comes in contact with dark schist, or talcous slate, as I have observed to be the case in other parts of Savoy and the Haut Vallais ; but the actual junction of the two rocks is not seen here. The temperature of the strongest spring is 99° Farenheit ; it contains 1·83 *per cent.* of saline matter. The second spring has the temperature of 95°, and contains 1·75 of saline matter. Other sources have been discovered that contain only 1·50 of salt. I was told that there is a deep and nearly inaccessible chasm in the rock behind the springs, which is supposed to have some connection with them. Beside common salt, the water contains in small proportions, sulphate of lime, sulphate of soda, and sulphate and muriate of magnesia, together with oxide of iron. Much of the gypsum in this part the Tarentaise being intermixed with rock salt, we may well conceive whence the water derives its saline impregnation ; but I am inclined to believe that the high temperature of these springs, as well as of all the thermal waters in Savoy, is occasioned by an intermixture of boiling water, which rises from immense depths, being heated and forced up by subterranean fire, like the hot springs in countries undoubtedly volcanic. During the great earthquake that destroyed Lisbon in 1756, the salines at Moutiers ceased to flow for forty-eight hours, and when they flowed again, their quantity was increased, but the saline impregnation was weaker. A similar effect was produced at the same time at the hot springs of Toplitz, in Bohemia.

It may seem extraordinary that the waters at Moutiers, which have only half the strength of sea-water, should repay the expence of evaporation ; but the process by which it is effected is both simple and ingenious, and might be introduced with great advantage on many parts of our own coast, should the salt duty be entirely removed. The salt works at Bex, in the Pay de Vaud, are nearly similar to those at Moutiers, but not on so extensive a scale ; and a very useful part of the process at Moutiers is not adopted at Bex. Having never seen an intelligible account of the process of evaporation by faggots, I shall endeavor to give such a description as will enable any person to imitate it in this country; indeed, so little is known of this mode of evaporation by faggots, that it has been often stated by English writers, and has recently been again gravely repeated, that it consisted in throwing salt water upon burning faggots, and gathering the salt that remained. This would be a mode of making salt, as wise and practicable, as the nursery method of catching birds by putting salt on their tails.

It is obvious that water so weakly impregnated with salt as to contain only one pound and a half in every thirteen gallons, could not repay the expence of evaporating by fuel, in any country. The water of the north sea contains 2¼ *per cent.* of salt, and yet it has never been attempted, that I know of, to make salt from it by evaporation with coal fires, even on the coast of Northumberland or Durham, where refuse coal, suited to the purpose, might be purchased for 1*s.* 6*d.* per ton. In order to make salt from the saline water at Moutiers, it was necessary to concentrate it by natural evaporation; and to effect this speedily, it was required to spread the surface of the fluid over as large a space as possible, the ratio of evaporation being, *ceteris paribus,* in proportion to the extent of the surface exposed to the action of the atmosphere. The first attempt at Moutiers was made in 1550, by arranging pyramids of rye-straw in open galleries, and letting the water trickle through it gradually and repeatedly. By this process a portion of the sulphate of lime it contained was deposited on the straw, and the water became concentrated to a certain degree. It was then carried to the boiler, and further evaporated by fuel. In 1730 the present buildings were erected by order of Charles Emanuel the third.

There are four evaporating houses, called Maisons d'Epines (literally, houses of thorns). Nos. 1. and 2. receive the water from the reservoir, and concentrate it to about three degrees of strength, viz. they evaporate one half of the water they receive. These houses of evaporation are three hundred and fifty yards in length each, about twenty five feet in height, and seven feet wide. They are uncovered at the top. They consist of a frame of wood, composed of upright posts, two and a half feet from each other, ranging on each side, and strengthened by bars across; the whole is supported on stone buttresses, about three feet from the ground, under which are the troughs for the salt water to fall into. The frame is filled with double rows of faggots of black thorn, ranged from one end to the other, up to the top; they are placed loosely, so as to admit the air, and supported firmly in their position by transverse pieces of wood. In the middle of each Maison d'Epines is a stone building, containing the hydraulic machine for pumping the water to the top of the building; it is moved by a water-wheel. When the water is raised to the top, it is received in channels on each side, which extend the whole length of the building; from these long channels it is made to pass into smaller ones by the side, from which it trickles through a multitude of small holes, like a very gentle shower, upon the faggots, where it is divided into an infinite number of drops, falling from one point to another. Being thus exposed to the contact of the air, it gains one degree of strength in falling, and, by the action of the pumps, it is raised again, and falls in other showers, till it has acquired the strength required for passing to the evaporating house, No. 3.

The process is conducted with less nicety in Nos. 1. and 2. than in the others, and, as I mentioned before, the houses are not covered. The pumps moved by the machine in the centre of the building, are distributed at equal distances on each side of the Maison d'Epines. The water is not always let to trickle down on both sides of the thorns, but only on that exposed to the wind. The two buildings, Nos. 1. and 2., are placed at different angles, to catch the different currents of wind that rush down the valley. No. 3. is constructed on the same principles as Nos. 1. and 2.; it receives the water from them both; it is three hundred and seventy yards long, and is covered to preserve the salt water from the rain. There are twelve pumps on each side in this building, and more care is taken to distribute the water equally; here it is concentrated to the strength of twelve per cent., and deposits most of its remaining sulphate of lime, in incrustations on the twigs.

The water being now reduced to about one seventh of the original quantity, and raised to the strength of twelve degrees, is passed along channels to the Maison d'Epines, N. 4. This is only seventy yards in length: here it is further concentrated by a similar process, till it nearly reaches the point of saturation, but this depends on the season. In dry weather, it is raised to twenty-two degrees; but in rainy, moist weather, to eighteen degrees only. In summer-time the whole process of evaporation, in passing through the different houses, is about one month; in wet seasons it is longer. The stream of water that sets in motion the hydraulic machines for raising the saline water to the top of the buildings, is brought by a small aqueduct from the river Doron. When once in motion, the process goes on and requires little farther attention, or manual labor, till it is completed. When the water is nearly saturated, it passes to a large building, where are the pans for boiling, and the salt is crystallized in the usual method. That the reader may form an idea of the quantity of water evaporated before it comes to the pans, I will state the reduction at each of the evaporating houses:

8000 hogsheads, when received at Nos. 1. and 2., contain about $1\frac{1}{2}$ per cent. of salt - - - - - - reduced to 4000

4000 hogsheads, when received at No. 3., contain about 3 per cent. of salt - - - - - - - - reduced to 1000

1000 hogsheads, when received at No. 4., contain about 12 per cent. of salt - - - - - - - - reduced to 550

550 hogsheads, received at the pans, contain near 22 per cent. of salt.

Thus, out of every eight thousand hogsheads, passing through the Maisons d'Epines, seven thousand four hundred and fifty are evaporated by the air in summer, and about seven thousand in winter; and only one-sixteenth part of the fuel is consumed, that would be required for evaporating the whole quantity of water by fire.

The faggots are changed at periods of from four to seven years. Those in Nos. 1. and 2. where the saline impregnation is weak, will decay sooner than in Nos. 3. and 4. In No. 3. all the twigs acquire so thick a coating of selenite, that when broken off, they resemble stems and branches of encrinites.

The Maison de Cordes was invented by an ingenious Savoyard, named Buttel. It is forty yards in length and eleven wide; it is much stronger than the Maison d'Epines, the roof being supported by six arches of stone work; the intermediate spaces on the sides being left open. In every one of these divisions are twelve hundred cords, in rows of twenty-four each, suspended from the roof, and fixed tight at bottom. The cords are about sixteen feet in length. The water is raised to a reservoir at the top of the building, and distributed into a number of small transverse canals, each row of twenty-four cords having one of these canals over it, which is so pierced as to admit the water to trickle down each separate cord, drop by drop. The original intention of this building was to crystallize the salt itself upon the cords, for which purpose the water was made use of from the pans after it had deposited a quantity of salt in the first boiling, to serve the expense of fuel in a second boiling; the residue-water of the first boiling, by repeatedly passing over the cords, deposited all its salt in about forty-five days, and the cords were incrusted with a cylinder of pure salt, which was broken off by a particular instrument for the purpose.* This process is at present abandoned for crystallizing; but the cords are still used for evaporating, and are found to answer better for the higher concentration of the water, than the faggots. This method did not answer for the first evaporation, because the water rotted the cords; but it was discovered that the cords were not soon injured by it, when it had acquired five degrees of strength. The cords, we were informed, had many of them remained thirty years in use, without being changed: indeed, they were so thickly encased with depositions of selenite, that they were defended from the action of the water. This mode of evaporating is found to be more expeditious than that of the faggots.

A sketch of the evaporating house, No. 1., is annexed; No. 2. is similar to it in every respect.

In the covered house, No. 3., there are twenty-four pumps, twelve on each side, to distribute the water more equally over the whole. This system of pumps is worked by joined bars of wood, which move backwards and forwards, and are connected by crank wheels with each piston, to raise and depress it. As I have before mentioned, they take care to evaporate on the windward side of the building. When I was on the top of No. 3., though the air was very warm, I felt an intense degree of cold, the consequence of speedy evaporation.

In the Maison de Cordes, it is found that the evaporation goes on more speedily in windy weather than in the Maisons d'Epines, as might be expected from the more ready access of air to the surface of the water. The cords are double, passing over horizontal rods of wood at the top and the bottom, to keep them firm in their positions, and at regular distances from each other. I did not see the cords without their envelope of selenite; but I was informed that they were not thicker than the finger. With the incrustations they were become as thick as the wrist.

Near the salt-springs there are the remains of a large reservoir, into which the water was formerly made to fall from a considerable

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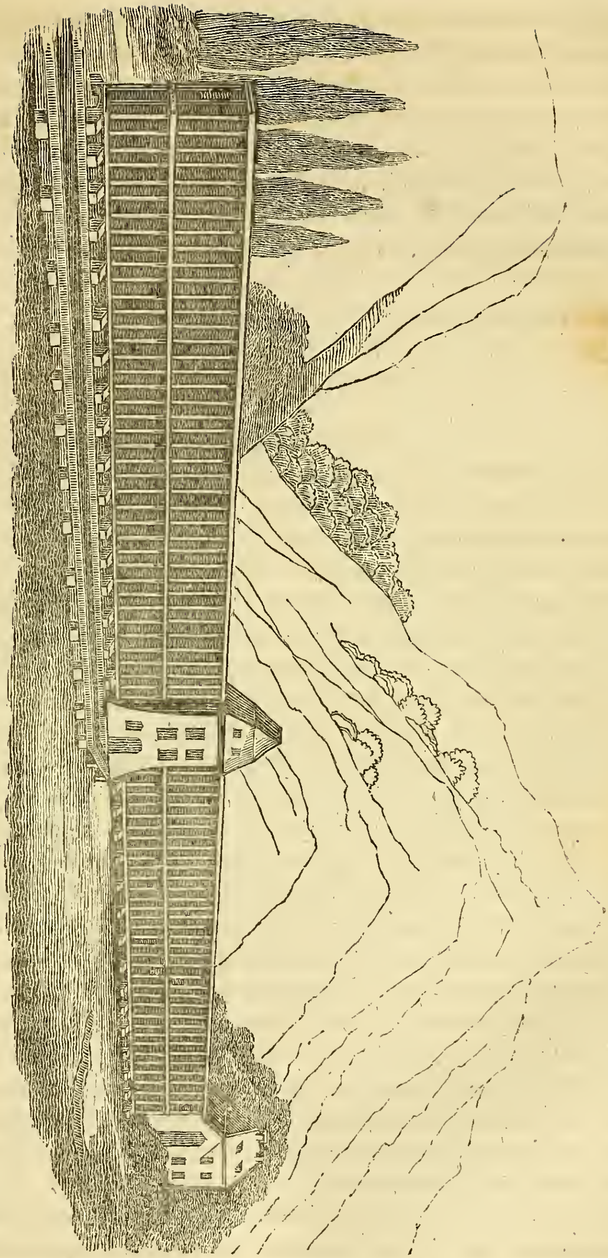
* This process might be used for sea-water with particular advantage in warm climates, and the necessity for boiling altogether avoided.



height by a machine; but this mode of evaporation was found to answer only in very hot weather, and the process is given up.

The saline water is received into reservoirs from the springs, where it remains some time before it passes to the Maisons d'Epines, and here it deposits a considerable quantity, or nearly all of its ferruginous matter; the canal along which it runs to the reservoirs is also lined with a red ochreous incrustation.

The total length of the Maison d'Epines is as under:

	Yards, English.
Nos. 1. and 2. together - -	700
3. - - - - -	370
4. - - - - -	70
Total,	1140, or nearly two-thirds of a mile.

The fuel used at the pans for the last process is partly wood, and partly anthracite from the neighboring mountains. The anthracite answers remarkably well when once ignited, as it preserves for a long time a regular degree of heat. The consumption of wood was formerly so great, that it has denuded many of the higher mountains in the Tarentaise, and exposed them to the action of the atmosphere, which has occasioned vast eboulements; for it is found that forests are of the greatest utility, in preserving precipitous mountains from destruction. The fact is now so well ascertained, that the government, for this cause alone, has lately paid particular attention to the preservation of the wood. The quantity of salt made here annually, is estimated at 100,000 myriagrammes, or about 2,250,000 lbs. avordupois, and about 9000 myriagrammes of sulphate of soda, or about 187,000 lbs. The other alkaline matter which adheres to the pans is sold to the glass-makers. The government receives, on the average, one hundred and fifty thousand francs for the products, out of which it is estimated that thirty thousand are expended for wood and fuel, eight thousand for materials employed in the buildings, and for faggots, &c., and sixty-two thousand for the wages and the salaries of the different officers, leaving an annual profit of fifty thousand francs. In some of the mountains of the Tarentaise, the gypsum is intermixed with rock salt en masse, and was worked by the peasants, but the places are now closed up, and so strictly guarded by order of the government, that I found it difficult to procure specimens.

These mines were formerly worked, the salt being separated from the gypsum by solution, and subsequently evaporated by fire; but the great eboulements, caused by clearing away the wood from the sides of the mountains, obliged the government to abandon the mines, and undertake the manufacture of salt at the Salines. These mines are mentioned by the Roman historians.

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The volumes from which the foregoing extract is taken, deserve a full notice in a Journal of Science. They contain many facts and views that are interestiug to science, particularly to geology, in which the author has shewn himself a skillful and independent observer. But the work is not to be regarded merely as a book of scientific travels; it is also popular, and interesting to all readers who value sound information on a great variety of the subjects which are among the most interesting to man. The vigor of mind, the candor and rectitude of judgment, and the power of exciting interest and conveying instruction, which the author, in still earlier years, discovered in his geology, are very apparent in his travels. Society, in domestic life as well as among the learned; the arts, useful and ornamental; historical facts, especially as connected with particular places and scenes; the face of nature both in grandeur and wildness, and in the loveliness of cultivation; these and many other subjects give diversity to the author's pages, and furnish entertainment and instruction for readers of various mental acquirements and taste.

Geology is a prominent subject, but in general, the topics of this nature are so arranged that they may be omitted by those readers to whom they are not interesting. To all who cultivate this branch of knowledge, they will however prove highly acceptable.

We have rarely met with a book of travels containing no perilous adventures, in which there is more that is at once interesting and valuable; it is a solid, manly, and useful production, and the animated style and discriminating observations of the author, prevent the book from becoming heavy. It seems however, not to be much known even in England, and not at all in the United States. If any thing which we can suggest should contribute to bring it more before the scientific and literary public of both countries, we should be gratified, especially, as the work is remarkably free from prejudices, and peculiarly from those which English critics often point out in their countrymen. It contains some fine colored engravings and numerous woods cuts from original drawings.

Art. III.—*Hawaii, (Owyhee,) and its Volcanic Regions and Productions; with some notices of the moral and civil progress of its inhabitants, and of those of Oahu.*

1. *Notices from a letter addreessed to the Editor.*

In former volumes of this Journal, we have repeatedly mentioned this interesting region, of past and present volcanic action. A letter received some months since, dated Byron's Bay, October 28, 1829, by the Editor, from Mr. Joseph Goodrich, (to whom we have been often indebted for valuable information,) mentions that in July, 1829, he had again visited Kirauea* and that he was surprised to see how much it had filled up since his last visit, the crater not being then so deep by six hundred feet as at the time of his first visit.† This is of course attributable to the subterranean effort to eject the melted matter, which has again congealed at the bottom of the crater and thus accumulated.

Mr. Goodrich has forwarded a box of the lava, and he states that "all the specimens were taken either hot or warm from the bottom of the crater; the light pumice stones were from the top of the crater, or the sunken plain, as Mr. Ellis calls it."

The volcanic specimens from Hawaii are singularly marked by the strong impress of fire. It would be impossible to doubt their igneous origin, even if one knew nothing of their history. Black is their prevailing color, but some are red or deep brown, and occasionally they are mottled and party colored, with various hues.

They pass, by almost imperceptible gradations, from compact augitic lava, heavy and almost without pores, to that which is in the highest degree vesicular and inflated. In general, they have a high vitreous lustre, attended frequently by brilliant hues of uncommon variety and beauty, iris-colored, columbine, of a steel tarnish, &c. Frequently they assume the characters of perfect volcanic glass.

As it appears decidedly, from facts quoted in Vol. XI, that the entire island is of volcanic origin, it is interesting to learn that there are rocks of basalt, ("answering very nearly to the description of the Giant's Causeway in the north of Ireland.") "Many of the prisms are six sided, broken off even with the surrounding rocks; others

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* Then evidently in tranquillity, as ladies and little children were of the party.

† See Vol. XI.

are thirty or forty feet high, presenting a mural front, and the superincumbent masses do not appear to differ materially from the trap of East and West Rock, near New Haven."* Beautiful cascades fall over some of these rocky ledges; some of them are one hundred feet and more in height.

Among the Hawaiian specimens, the red lavas, by decomposition, afford a red clay, which is used by the natives as a paint. Sulphur, of a pure yellow, is also frequent. Capillary volcanic glass was mentioned in a former notice of the igneous productions of this island; it is sometimes so fine as to be blown away by the winds and to be rolled along and accumulated in winrows. A tendency towards forming it is exhibited upon the lavas now before us. Frequently the exterior is covered with glassy fibres, cemented to and enveloping fused masses of vitreous lava.

2. *Notices of Kirauea and of the contiguous region, in a second visit of the* Rev. CHARLES STEWART.

Remark.—In Vol. XI, we gave an analysis of the tour of the missionaries around the island of Hawaii, and endeavored to condense into a connected view the principal facts relating to its volcanic character and phenomena. We also republished a revised letter of the Rev. Charles Stewart, containing an account of his visit with Lord Byron to the great crater of Kirauea.†

From the interest manifested in those notices, both at home and abroad, we are persuaded that the following will also prove acceptable. They are taken, by permission, from the sheets of the (as yet) unpublished visit of the Rev. Mr. Stewart to the South Seas, with a sight of a part of which he has been so kind as to favor us. In this, his second visit to the South Seas, he went as chaplain of the Vincennes, an American national ship of war, commanded by Captain Finch, and the public may expect soon to see Mr. Stewart's own account. The part which we have been permitted to examine is, like Mr. Stewart's former volume, replete with interest and instruction.

The peculiar design of this Journal does not embrace that part of Mr. Stewart's narrative which relates to the progress of civilization,

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* With which Mr. Goodrich was familiar while at College; these rocks are greenstone trap, reposing on sandstone; they greatly resemble, both in texture and position, Salisbury Craig at Edinburgh.

† See Vol. XI, p. 362.

and of moral and religious influence. While passing, however, to our more appropriate objects, we feel little disposition to suppress the pleasure we feel or to apologize for expressing it, while we contemplate the wonderful results of the labors of the men of peace and love, who have gone into voluntary exile, and fixed themselves on the coral rocks and among the volcanic fires of the vast Pacific; who have, in a few short years, converted many thousands of barbarous and degraded savages into civilized and Christianized men; whose high moral character, whose pure and courteous manners, and whose advancement in the arts, and in political happiness, are a constant theme of astonishment to the navigators who throng that great highway of nations. If, while we are citing the facts respecting volcanic agency, which we have derived from Mr. Stewart, we intersperse some passages, illustrative of the topics to which we have just alluded, we trust that every reader, who loves mankind as well as natural knowledge, will pardon the digression.

In order to estimate justly the condition of the great volcano of Kirauea in 1829, the period of Mr. Stewart's second visit, it is necessary to recur to the account of the first in 1825,* and if in the present sketch, the scenes exhibited are more calm, they are not less instructive.

On the 2d of October, 1829, the Vincennes anchored off Byron Bay in Hawaii; a hasty visit was paid to the shore by Mr. Stewart and a part of the officers, a stay of only half an hour being allowed them with the mission family of Mr. Goodrich and with the Christianized natives, many of whom, recollecting Mr. Stewart, kissed and embraced his hand, shedding tears of joy, or sank at his feet. The party having regained the ship, which was waiting in the offing of the bay, her captain was induced, by the state of the wind, to relinquish his purpose of immediately sailing for Maui, and to tack and stand into the bay. When the boat left the ship in the morning, she was nine or ten miles from land, towards which a tremendous swell was setting, and it seemed at the hazard of life that the party jumped into the boats, as they rose and fell ten or twelve feet with every returning billow. Yielding to the waves and the wind, and "by spreading a mountain of light sail," they were gently fanned in.

As they entered the bay, the rays of the declining sun gleamed brightly over the wide extent of open champaign country, distinguish-

* See Vol. XI.

ing this part of Hawaii from that of every other island in the Pacific which the traveller had visited—presenting its broad lawns and dark groves, in lights and shades of exquisite beauty, and in every variety of verdure, from that which seemed almost white to the deepest green.

From the lofty, but primitive looking chapel, as a centre, the humble dwellings of the fisherman and the farmer were seen, widely scattered in every direction; some skirting the beach, as it swept round in the beautiful curvature forming the bottom of the bay; some hanging on the cliffs of the bolder shores; some just peeping from the thick foliage of a grove more inland, or slightly screened by the shade of a small clump or single tree; and some, again, standing unsheltered and alone, in the midst of a wide spreading field. Such was the foreground; while behind, an extensive country, marked in two or three places by old, long extinguished, and now verdant craters—rose gradually for miles, to the stately forests enriching the broad bases of Mounaroa and Mounakea, both in distinct view—the first appearing far in the south, above and beyond a line of green forests, in one long, regular, and distant arch of blue—the last, seemingly near, and towering loftily against the western sky, in irregular and broken summits of gigantic magnitude.

The admiration of all on board, says Mr. Stewart, was greatly excited by the scene, which, in the simple luxuriance of natural beauty, was one of the most rich and lovely.

As is almost invariably the case in this district, heavy showers of rain fell during the latter part of the night and morning.

On the 9th of October, the party which had been formed to visit the volcano at the foot of Mounaroa, thirty five miles inland from the harbor, commenced their tour. There were eleven gentlemen of the ship assisted by twenty natives and a servant or two, and their route was that which is exactly described in Mr. Stewart's former volume. We shall, as far as possible, use his own language with occasional abridgment, and such slight modifications as may be necessary to connect the facts without injuring the sense.

We accomplished, says the author, fourteen miles just after four o'clock; and finding at that distance excellent accommodations for the night, determined to sleep before proceeding farther. The establishment—consisting of three houses, situated a short distance from the road, on the borders of a fine tract of land, having very much the appearance of a large plantation of intermingled arable and meadow grounds at home, and just at the edge of a fine forest running from the sea to the interior—belongs to Kinai, the head man of the thinly inhabited district of Ora. The master and his family were absent, at the distance of thirty or forty miles, superintending the cutting of sandal wood, and the charge of the houses was left to a few domestics, who, however, received us very kindly; and, at once, surrendered to us the principal habitation.

Here we were quickly made sensible, that the improvements and advancement of the people are not limited to the sea ports or to the coast. The house was divided into separate rooms by screens of native cloth and mats, furnishing distinct sleeping places for the inmates, besides one large and airy apartment, evidently kept as a better and principal room. Into this last we were shown, and its neatness and comfort were a great luxury to us.

The finer mats for the floor, were, in the absence of the chief, economically rolled up against one side of the house, and other derangements, from the same cause, of the ordinary articles of use, were observable—so that we did not see the establishment in its best state. Still, every thing testified, in my eyes, to a vast improvement in the style of living, (since my former visit,) even among the inferior chiefs. Among other evidences of advancement were the books printed in the native tongue, (as yet few in number,) well bound and wrapped in covers of native cloth; and a large slate, suspended against one of the partitions.

But that which our party hailed with peculiar pleasure, was a fine lounge or divan, eight or ten feet in width, and extending the whole length of the apartment. It was composed of a great number of thicknesses of mats, on a platform of wood, elevated about two feet from the floor; and, surrounded by curtains of neat furniture chintz, it afforded a couch for the whole of our number, which we might have coveted under circumstances of much less fatigue.

Indeed the comfort of the accommodations—a refreshing cup of tea and a snbstantial supper—the novelty of every thing around—freedom from the confinement of the vessel, and with it, from the tedium of the night-watch, and other inconveniences of nautical life, gave such a flow to the lively spirits of some of our younger companions, as to make it a late hour, before we were composed to quietude and to sleep.

Nothing of particular interest occurred the next day, till we had arrived in the immediate vicinity of the volcano. The smoke ascending from it was discerned at a much greater distance (ten or twelve miles,) than on my former visit; and was so massive in its columns, as to promise a high state of action. I regretted to ascertain, that the only hut now standing, in which we could find shelter, was at a different place from that which we had occupied in 1825; and that, in going to it, we should approach the crater in a different, and less striking manner. I was wishing to have all my first impressions and emotions renewed; and, in the disappointment, almost lost the wildness and beauty of the more gradual descent of the precipices, which we were making, by a path which branched off from the old one, just as we were coming upon them. The nearness of night, and a threatning appearance of rain, however, left me no alternative—and I hastened on with my companions, to catch a first view, under whatever advantages the new approach might offer.

Our arrival at the volcano was more sudden than I had expected it to be. I had been looking for some more abrupt descent than any we had yet made, and was straining my eyes into the vast body of thick and heated smoke—rising high to heaven and spreading widely over the whole hemisphere to the south—for at least a glimpse of the tremendous gulf from which it issued; when almost without warning, we found ourselves entering heavy currents of steam, rising rapidly from crevices and deep fissures about our path, and extending, at intervals, on one side, to the smoke from the crater, and on the other, to a low precipice, flanking our right. On turning towards the latter it was seen in many places, even to its very top, to smoke like a coal-kiln. The whole surface of the level on which we were—a plain a mile in length and half a mile in breadth, inclosed on the edge of the crater by a sweep of the precipice—exhibited, in a greater or less degree, the same evidences of wide-spread subterranean burnings.

The trade-wind blew freshly, and swept the dense steam and highly heated air, bursting from the ground, in strong currents and whirling eddies across our path; and, at the same time, bore before it above, a thick and gloomy scud from the sea, flying so low as to brush swiftly through the trees on the top of the precipice, and, at times, to be scarce above our heads. Every thing wore a foreboding and saddening aspect: and, whatever I felt I had lost in a clear and distant view—like that enjoyed when with Lord Byron—the sight of the hut, which was to be our sleeping place, still far ahead, and, seemingly, in the midst of the admonitory signs of a dangerous substratum, gave rise to a sense of exposure, and to apprehensions, not experienced on the former occasion.

The rude lodge which we were to occupy, open in front, and only slightly thatched on the side next the wind, stands two or three hundred yards from the edge of the crater on the north end, but does not command a view below; we, therefore, scarce stopped at it, but with impatient eagernesss, hurried to the brink. It was, however, only to meet with disappointment: the smoke in the whole chasm, was so dense as to be utterly impenetrable—a flickering flame was to be seen, only occasionally, here and there through its thickness; and, now and then, a sudden flash, sending an illuminated column high towards the summit. Still the sight was deeply impressive. It was evident that the perpendicular depth, from our very footsteps down, was tremendous, and seemingly unfathomable; and the obscure outline of the upper edges, sweeping off on either hand till lost to the eye in the smoke, gave an impression of awful immensity, disposing one to shrink back from such alarming proximity.

Another cause of disappointment, was the absence of those terrific noises, which on my first visit, were constantly bursting on the ear; now scarce a sound was to be heard, except the rushing of the wind, as it swept over the edges of the cliffs, to replace the more rarefied atmosphere within—unless it were an occasional indistinct sigh—a half smothered murmur—and now and then, as a lull or eddy of the wind rendered the hearing from that direction more distinct, the hiss of escaping steam, and something like the simmer and the bubbling of a mighty cauldron, mingled with the distant sound of a surf, rolling on a pebbly beach.

There was in this assemblage of images—in the lowering sky and driving wind—in the riven and steaming ground—in the heavy masses of smoke rising from the hideous chasm beneath, as if from a bottomless pit—and in the oppressive and saddening sounds occasionally coming to the ear—that, which was well suited to the recollection of years gone by, and of friends afar, who had once shared with me in the enthusiasm of high wrought admiration, excited by the same object. And, in the indulgence of

—"a mood of mind we all have known,"

thus induced by circumstances and by the scene, I lingered on the brink till completely chilled, by the increasing freshness and dampness of the breeze.

The rude hut, or rather screen against the wind—consisting of poles propped in a slanting position, and covered on one side only with a few leaves of the sugar cane, and bushes slightly placed upon them—we thought for a time very comfortable, and wisely located as to temperature; being on a spot of ground of such grateful heat, compared with the rawness of the mountain air, as to lead us to congratulate ourselves in the advantage it afforded, as we sat on our various packages in front, and partook of our evening repast, within a foot of a crevice, from which steam issued of such power as to cook our potatoes in a short time, without the aid of fire. But when we came to take possession of the mats, strewn inside of it for beds, we found ourselves in quarters considerably hotter than those, in which, Colman the poet puts *his lodger over the bake shop.* You will scarce believe, that we all slept on a temperature of 120° Fahrenheit —but such is the fact: and it was well the air above was as low as 56° or 60°, so that by frequent turnings, we could let one side cool, while the other was heating, or we should have been well-nigh parboiled by morning. There was no alternative however—it was the only shelter—and as there were dashes of rain through the night, it would have been almost death to have slept, in the open air, on any cooler bed. We, therefore, made the best of the necessity; and after many a turn of restlessness, and some impatience, and forebodings, we obtained a tolerable night's rest; and were quite reconciled to our dormitory, when, on rising, we found that the continued vapor bath had dissipated, almost entirely, the stiffness of limbs which most of us had suffered, from the length and rapidity of our walk.

I rose at midnight, and went to the crater. The steam from above was still driving, in thick volumes, over the cliffs; and with the smoke from below, rendered every thing obscure; but various seats of fire, in tremendous action, sent up flashes of light through the dimness, to the highest clouds, and, at times, converted the whole body of smoke into one lurid mass. Some of the spots, apparently most liquid and most agitated, were situated immediately below the place where I stood; and, now and then, the fiery streams in them, circling widely and swiftly in different directions, glared on the eye, in all the regularity and brilliancy of the lamps of an orchestra. But as these exhibitions were but fitful and obscure, compared with what I had on a former occasion beheld, and the wind bleak and piercing, I was glad to make a hasty and shivering return, to the warmth of my couch.

The morning, with a sky of the purest blue, was bright and beautiful, and afforded us splendid views of Mounaroa, seemingly close at hand and tinged with purple, and of Mounakea far behind us in the distance. I was at the crater again, before sunrise; and followed its brink a half mile or more westward, with an opportunity of distinguishing, for the first time, its characteristic features. But the light of the day had extinguished the fires—where, in the night, the principal action had been observed, nothing could now be discerned but smoking lakes, or black cones, tipped with pale, sulphureous flames.

In an excursion with two gentlemen of our party, who were in pursuit of ducks, we found whortleberries, which covered the surface in rich clusters, and beyond the rising ground, over which we were walking, we found abundance of the finest strawberries, principally, in an open meadow-like spot, skirting a wood of noble trees of the Eugenia and Acacia.

In returning, we passed by the pools, furnishing visitors with the only water in the vicinity. Its preparation is a kind provision, not only for the weary traveller, as he occasionally crosses the island at this wonderful place, but for the fowls of the air, which, at most times, find security in the regions around—I say *preparation*, for the provision, though natural, is strictly such; and one of the most singular in the world. It is by the condensation of steam, escaping from holes and crevices in the ground, immediately to the windward of a bed of earth and lava so hard and compact, as to be impervious to water, and into excavations and natural basins, of which the drops, formed by the effect of the cold wind upon the vapor, fall, and furnish a constant supply of the purest water. I looked with admiration, on the simple process ever taking place, and thought with wonder and gratitude of the wisdom and goodness of the Almighty, often displayed in the economy of nature, in which circumstances seemingly small and unimportant, are not only highly conducive to the comfort, but vitally essential to the well being of his creatures.

Soon after breakfast we began to prepare for a descent below; and, before long, were all marshalled and equipped with long canes, water flasks, &c. for the undertaking. Directly in front of our sleeping place, and entirely round the western side, the descent to the edge, or offset, is a perpendicular wall of nine hundred feet; we, therefore, went a quarter or half a mile to the east, by the direction of our attendants, many of whom had, within the last two or three years, been here with several successive parties. On coming to the path leading down, I was quite surprised to find the commencement of it so different from that of my former descent. Indeed, I did not know, till then, that any part within the upper circumference, presented such an aspect—at a single view, affording the most conclusive proof of the kind of process going on, in the undermining of the surrounding mountain; and of the manner in which the enormous fires beneath are fed, when old masses of matter upon which they have been acting, become utterly reduced to scoria and ashes.

After an almost perpendicular descent of eighty or a hundred feet, —in accomplishing which, we at times, hung from rock to rock,—the path came upon an extent of gronnd, half a mile in length and a quarter broad, broken into abrupt hills and deep glens, and covered with grass, shrubbery, and small trees. The whole declines gradually, several hundred feet, towards the crater, and constitutes a little valley, separated from it, by a succession of barren hills, and of volcanic rock and sand. It had evidently been shattered into its present forms, and sunk from the level above, at no very remote period, in some convulsion, after its foundations had been sapped by the element still raging beneath. And it is not improbable, that, even now, the whole is suspended on some comparatively slender base, till another throe shall open for it a descent into a raging abyss, to be converted, in its turn, into a mass of liquid fire.

The scenery, here, was strikingly unique and romantic; consisting, above and behind us, of the bare and perpendicular face of rocks, from which this section had been rent as it came down; and of a succession of miniature mountains and ravines, thrown into every wild form, and still beautifully verdant with various growth. The path winding over and through these—though plain and seemingly safe—is, in truth, the most dangerous that I have met with in the whole region. In many places, the bushes and grass skirting it, either partially or entirely conceal the most horrible pits and fissures, into which, almost without knowing it, a single false step, or a slip, might plunge one to be heard of no more. In several instances, when least dreaming of danger, I have come upon some of these, with a suddenness and want of caution, that have made my blood curdle, as I ventured a gaze, into their yawning and unfathomable mouths. Once, in particular, the first intimation I had of being near any thing of the kind, was given by the heat of the steam issuing from it and striking against my face—my feet being already on the very brink. It was sufficiently large to admit the stoutest man entire; of a depth to which the eye could not reach; and filled with vapor scalding hot! To have fallen into it must have been instant and irrecoverable destruction. In another place the path led over a crack—to all appearance without bottom, several feet in width, and extending on either hand as far as we could distinguish—by a single narrow arch of a foot's breadth only, in the manner of a natural bridge, from which a deviation of a single step would have been fatal.

After traversing this singularly located glen, we found ourselves still four or five hundred feet above the ledge, within the crater: and the descent to it, very abrupt and difficult, from the hardness and smoothness of the lava of which, chiefly, it is constituted. In many places, large streams of no very ancient date—since they cooled and hardened in their running form—marked the sides of the cliff: and by a principal one of these (resembling a cascade still pouring down the face of the hill,) most of our party, in slow and necessarily cautious progress, reached the offset, or natural gallery, running round the chasm.

Here the changes that have taken place since 1825, first became striking. The general features were much the same; but almost every spot, when looked upon in detail, shows evidence of new and tremendous action of fire, and of convulsion after convulsion, that must have shaken every thing far and wide. The greatest alteration, however, is that of which I had been apprised namely, the filling up of the whole surface below the ledge, at least two hundred feet. The depth below this, was estimated by Lord Byron's party, at five hundred feet—at present it cannot, on an average, be more than two hundred. Many of the highest of the cones have, thus, been much reduced in their loftiness; and many have entirely disappeared. In all other respects, the general surface and aspect are the same: there is however much more fire in the north end than formerly, and the very route we took, in crossing the bottom at that time, is now a chain of liquid lakes, from one side to the other.

My first walk on the ledge was westward—the same direction in which I went when with Lord Byron—but I had not proceeded half the length of the northern side, before the way was interrupted by a sulphur cone, which has risen on the ledge; and which was surrounded by such a suffocating vapor, as to prevent my passing. I therefore returned to my companions, who were busily employed, in gathering curious specimens of a variety of kinds, till I should return to accompany them down the remaining distance to the bottom.

By the rising of the lava, the difficulty of making the descent is, in a great degree, done away in those places where it was ever practicable; and it occupied but a few moments to go down. The surface is more broken and distorted than ever; and presents a truly hideous mass of ruins. There being much more fire at the north end, than in 1825, the currents of heated gas and air are more numerous, and more strongly impregnated, and consequently, an examination is more hazardous. Our number became divided into separate parties —one of which went far into the middle of the northern section, and they believe themselves to have been at the very edge of the largest lake, seen in powerful action the night before. The specimens of sulphur, collected from its border, are of the finest and most beautiful kind, but so recently formed and so delicate, as to be very difficult of preservation.

In the course of the two or three hours which we spent at the bottom of the crater, we visited four cones—all of them being centres of very active fires. The first was almost encrusted with sulphur, and could be approached only on the windward side, from the heat and suffocating vapor in every other direction. This was only a few feet high; and we got near enough to touch the sides and top with our canes. Though smoke and steam were projecting from its top with great force, and considerable noise, we perceived no flame or liquid lava: but the roaring of mighty fires below was distinctly heard; and so near, that the adventure which brought us within the hearing of its undulating and deeply menacing sounds, was thus proved to be one of great temerity.

The eager curiosity, however, which rendered us in a degree insensible to the hazard of our situation, was afterwards more completely gratified, in a visit to two other contiguous cones, much more lofty and unique, and altogether more imposing in their state and aspect. They were situated a mile farther south, along the eastern side; and our attention was called to them by the loud hissing and laborious action of steam, and by the flames which, occasionally, flashed from their summits. They were each about twenty feet in height, not more than sixty in circumference at the base, and tapering almost to a point at the top; having been, evidently, formed by successive slight overflowings of lava, which, as it rolled down, cooled into irregular flutings, ornamented with rude drops and pendants, and long, tapering stalactites.

By the nearness of our approach, in the examination of these cones, we were greatly excited, although, judging from the tremendous roar within, the irresistible force and deafening hiss, with which the steam rushed from every opening, and from the flames which flashed up, followed by lava white with an intensity of heat, the action beneath must have been intense—still the incrustation of scoria immediately around, seemed firm, and was less hot, than in many other places: admitting, not only of our coming close to the sides of the cone, but also of clambering some feet up them, till we could run our canes into the orifices at the top, and withdraw, with their burning ends, red hot lava, on which we readily made impressions, with pencil cases and naval buttons.

Even the slightest touch, however, with our sticks against the molten lava, produced an increased rush and roar from below, with an angry spitting of the fiery matter high in the air around us; and, more than once, we hastily retreated, anticipating a more violent eruption.

So much of novelty—so much of fearful sublimity attracts the attention and calls for admiration, on every side, that day after day, in place of a single morning, would be insufficient to exhaust the points of interest in this grand object: and we regretted the necessity, that hunger, thirst and fatigue imposed upon us, of taking leave of the depths to which we had descended.

The ascent to our cabin, by the same path we came, was toilsome in the extreme; and but for the refreshment derived from the whortleberries—after having surmounted the first cliffs—we should have been almost entirely overcome.*

* The first evening of our arrival from the bay, while standing on the edge of the crater, a sudden blast of wind brushed from my head a Leghorn hat, which I had worn to shield my face, by its broad rim, from the sun; and in an instant swept it out of sight over the precipice, as was then supposed, beyond all recovery. But, while at dinner, after having reached the hut, we were alarmed by the running of one of the natives from the crater, calling, in great agitation, for a rope, which had been used in lashing our provision chest; and on hastily demanding what was the matter, we learned, that an islander, when below in the morning, had caught a glimpse of the hat, lodged on the face of the precipice over which it had been blown, a hundred feet or more below the summit; and, that on coming up, he had gone over the brink, and by a most frightful effort, had succeeded in gaining possession of it. After making his way back, however, till within twenty or thirty feet of the top, he found it impossible to ascend farther; and was then standing on a single projecting stone, in danger every moment of losing his hold, and of being precipitated to instant destruction, down a wall-faced cliff of at least nine hundred feet!

The remainder of the day was given to repose. As the darkness of the night closed around us, however, we took a station in sight of the crater, and, wrapped in our cloaks, sat in the fresh wind on the precipice for an hour or more, catching occasionally through the smoke, exhibitions of great beauty and sublimity. But there were none to prevent a feeling of disappointed expectation, on my part, in comparison with the high gratification before derived from the same object: and I returned to our lodge with my companions, thinking that I must remain indebted to my first visit, for the sublimest impressions ever made on my mind and feelings, by a work of nature.

In this, however, I was mistaken. After some hours of sound sleep, I awoke; and perceiving the smoke and clouds over the volcano to be splendidly illuminated, hastened with a glass to a point of observation. A very sensible change had taken place in the liveliness of the seats of fire—in the vividness of the flashings of light—and in the sharpness and force of the sounds from various parts. I had been seated about ten minutes, fixing, with great delight, the field of the telescope on one and another of the cones, and on the lakes and rivers of bright lava, when a sudden hissing and mingling of confused sounds, accompanied by a brilliant glare of flames almost directly beneath me, attracted my attention, and led me to direct the glass to the spot. In doing this, I was presented with a spectacle, which, even imagination itself can scarce rival.

The power of the glass was such as to bring the scene, seemingly, within touching distance; and to make me involuntarily recoil, from the apparent proximity. A lake, a half mile or more in circumference—and probably but just unclosed—was raging in all the

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We shuddered at the possible catastrophe—but seeing a sufficient number of the natives collected, to render any assistance which might be practicable, we waited in silent agitation; not wishing to witness an event which we had no power to arrest. In a few moments we had the happiness to perceive, from the general movement and appearance of his companions, that the attempt at rescue had been successful; and, shortly after, pale as death—trembling like an aspen leaf—and covered with a cold sweat, he came and laid the old Leghorn at my feet!

The hat was not worth a moment of anxiety, much less such an exposure; and, while I rewarded the intrepidity, I felt disposed to reprove the rashness of the young man. None but the kindest and most disinterested motives induced the attempt—a principal one, doubtless, being that of seeing me under the necessity of resorting to a turban of silk handkerchiefs, to shield my head from a noonday tropical sun—and though alarming in its possible consequences, the motive merited commendation and grateful acknowledgment.

tumult of a tempest at sea. At first, the agitation was perpendicular—precisely that of a boiling cauldron—tossing up masses of the red-hot matter, in a bubbling action, fifteen and twenty feet, with a rapidity of motion, equal to that of the most heated boiler. Then came a long, regular motion from the south, heaving before it a fiery surf, whose crested billows rose, and broke, in sheets and spray of fire, like heavy billows sweeping over a reef to the shore! The effect was almost too fearful to be gazed on; and, for a moment—in forgetfulness of the distance and safety of my location—as billow after billow rose higher and higher and seemed ready to dash over me, with an exclamation of horror, I dropped the glass and closed my eyes upon the sight.

I would have run for my fellow travellers, but feared, that before they could be aroused and would reach the spot, the aspect of the scene might be entirely altered. This indeed would have been the case; for, in less than fifteen minutes, the agitation had entirely ceased; and the surface soon became less bright and fiery than that of many other spots. I waited a long time, hoping to see it renewed, but in vain: and then returned to my couch under an excitement of varied emotions, admiration, awe, and deep humility; by this scene I was repaid a hundred fold, for all the fatigue and exposure of the journey.

In the nearness and distinctness of the view, and in the clear perception of the form, character, and power of the action, it far surpassed any thing beheld on the nights I was there with Lord Byron—although the general exhibitions, at that period, were far more beautiful, and less obscured by smoke, than during this visit.

Early on Thursday morning, our encampment was in the bustle of preparation for a return to the bay: and breakfast was finished, and our long procession formed, by half past six o'clock. The weather did not promise much in our favor. The clouds were low and scudding—every thing wore rather a gloomy aspect—and we had scarce accomplished three miles, before it began to rain; and in a short time, we found ourselves in a perfect storm. There was no alternative, however, but as rapid a march as possible. With stiffened and swollen limbs and feet, shoes very much the worse for service already performed, stores nearly expended, a driving rain in our faces, and a walk of twenty miles to accomplish before we could reach a shelter, we did not feel much disposed to be facetious; and formed a procession rather silent and wo-begone, compared with the buoyancy, with which we had hurried over the same ground, two days before, and at noon arrived at the residence of Kinai, the petty chieftain of Ora, and found his establishment tenfold more welcome than before. We were all drenched with rain, and in a state greatly to relish the luxury of a large fire, and a change of clothes, which our portmanteaus still fortunately afforded; and thus sheltered and refreshed, we were exhilirated by the storm, when screened from its power.

We marched again in the morning; and after a walk, rendered very fatiguing by the wetness, and excessively bad state of the road through the wood, we found a boat in waiting for us—so that we were safely on board the Vincennes in time for dinner.

Miscellaneous facts relating to Scenery, Manners, &c.

It will be remembered, that the mountains of Hawaii are very lofty, some of them far surpassing Mont Blanc, and even emulating the higher Andes. Water falls are, therefore, to be expected in countries which abound so much with rain. Some of these were visited by Mr. Stewart, and his party. On the river Wairukee, the natives amused the spectators by leaping from the precipitous banks, thirty, forty, and fifty feet high, into the basins below, and gliding down the falls, with the greatest apparent hazard. One of the cascades resembles much the most admired sections of the Trenton falls on the Canada creek, in the state of New York, and similar casualities have signalized both places.*

Another cascade, one hundred and ten feet in height, pitches over a natural bridge, or rather a projecting arch, which rests upon abutments of basaltic rock forming precipices one hundred and fifty feet or more in height; in form and regularity of arrangement, they are precisely like the Giants' causeway, which, in a country where every thing appears to have been produced by fire, is a fact of great importance as to the origin of the trap rocks. This cascade falls into a basin of some hundreds of yards in circumference, which is as placid as a lake, except where the stream plunges into it from above, and the silvery mass appears to be poured from the blue bosom of the sky† into the depths below.

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* A young native female reaching after flowers, which grew over the precipice, and trusting to a branch of the tree on which they grew, was, by its breaking, thrown into the whirling eddies of the gulf below, and instantly lost.

† This appearance, so well described by Mr. Stewart, is presented in a most remarkable manner on the American side of the Niagara falls; when the observer

Another water fall in the interior was reported by Mr. Goodrich to be three hundred feet high.

From the fine prismatic tints observed in the spray, the natives call these water falls the cascades of the rainbow. Many old craters are observed near the shore at this place. The truncated summit of the highest is half a mile in circumference, and three or four hundred feet in elevation. It is observed that the sides of the ruins next the ocean, are the lowest, evincing that they disgorged in that direction. There are fine views of the surrounding country from the summits of the craters.

Worship of the Natives.

Early on the morning of the sabbath, a few of the islanders, wrapped in their large mantles of various hues, appeared here and there, issuing from the groves and hills; and the numbers increased, till crowds of both sexes, and all ages, formed an unceasing procession towards their chapel, which, although an immense structure, capable of containing many thousands, was entirely filled so that the naval gentlemen found it very difficult to advance to the place assigned them near the pulpit, without treading on the people who were sitting on their feet on the matted floor, and presented almost a continued mass of heads, over about nine thousand square feet, and crowds without the door could not obtain admittance. Their appearance was in the highest degree reverential and interested, although this is the most obscure corner of the Island, and the people the least removed from their primitive state, either in dress or manners. Only four years before (Mr. Stewart observes) it was very difficult, even with the example of some principal chiefs, and with the persuasion of the missionaries, to collect an audience of one hundred persons.

We cannot enlarge on this topic, which, however interesting, is not appropriate to this work, and will conclude these citations by adding, that the natives refused to enter into any traffic with the seamen from the ship on the sabbath, although they gave them watermelons and bananas; that their females uniformly withdrew from their approach, and took refuge in their families; that an entire moral change had taken place; instruction of every kind is eagerly sought; one hundred

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approaches as nearly as possible to the bottom of the cataract, and looks up through the torrent, as it doubles over the barrier of rocks, it appears to him a mighty deluge bursting from the heavens.

thousand people had then recently assembled at an examination of schools; the mission house was crowded with earnest inquirers, and evil customs, and atrocious vices, were abandoned.* Along the whole coast no noisy drum of heathen carousal, or rude song of obscenity, is now heard—but in their place, the hum of the crowded school, the voice of thanksgiving and prayer, and, not unfrequently, the chanting of the morning and evening hymn.

These changes, as Mr. Stewart justly observes, are best appreciated by those who have formerly known the inhabitants of this coast in all their rudeness, vice and ignorance.

Scenes and events in Oahu.

Oahu is two hundred miles from Hawaii, and as the ship (on the 13th of October,) bore away from the latter, Mounakea, its highest mountain, continued so long visible as to convince the observers that, if not eighteen thousand feet according to the usual estimation, it is, still, among the highest mountains of the globe.

As they entered Honolulu, the port of Oahu, a pilot conducted them into a harbor filled with whalers, and merchantmen, and with native craft, exhibiting the activity of commerce, usual in civilized countries. Here are foreign consuls, resident European and Amercan merchants, a dock yard, vessels on the stocks, and permanent stone buildings; and the daily arrival of vessels has ceased to excite surprise.

The meeting of Mr. Stewart with his missionary friends† and others, was of course, very interesting, and the courtesies of civilized life, practised between foreign powers, were not forgotten; eighty eight guns were exchanged between the Vincennes, on the one part, and on the other, the fort, and king Tamehameha's finest vessel of war, which is kept in naval order in the centre of the port, with a long pennant banner and jack flying. The presentation to the king Kauikeaouli or Tamehameha III, was marked by many circumstances

* "From many an humble dwelling now ———
——————————— is daily heard
The voice of prayer ———————————
And even in the hut of the child murderer
——— the father with his offspring dear,
Now bends the knee to God, and humbly asks
That he would bless them with a parent's love.

† Mr. Bingham, Mr. Ruggles, and others.

of regal splendor. Within the king's grounds, (from intrusion into which a high fence kept off the populace,) every thing was in a high degree, neat and orderly. There were separate houses for the king's household, and for the offices and sleeping room of the king.

The palace of thatch is more than one hundred feet long, fifty or sixty broad, and more than forty high, beautifully finished and ornamented with fern leaves, and furnished with a pebbled area.

The royal guard was composed of two hundred men, forming a double file, and wearing a white uniform with scarlet cuffs and collars, and black caps; their commander Kahuhu, was dressed in scarlet with gold lacings and an expensive sword. As Capt. Finch and party passed the gate, they presented arms in exact military style, and the commander of the kings' forces, Kekuanoa, receiving them in the full and rich suit of a major general, and with the gracefulness of a polished gentleman, ushered them through the glass folding doors into the interior of the palace. It is in one vast apartment, the timbers being in sight, and the wood beautifully hewn and contrasted with braided lashings of the bleached fibre of the cocoa, wrought into tasteful patterns and applied at close and regular intervals, so that the posts and rafters have the appearance of natural sections. The thatch of the building is also concealed from view by an elegant native tapestry, made of a brown mountain vine tied together like the bamboo window blinds; one continued tissue of this fabric is extended from the floor to the peak of the roof through the whole apartment between the timbers and the thatch, and thus imparts a very rich appearance. The floor, instead of rushes or grass which were formerly the foundation for the mats, was made of stone and mortar as hard and smooth as marble. Upon this, beautifully variegated mats of Tauai were spread—forming a carpet as delightful, and appropriate to the climate, as possible. Large windows on either side, and the folding doors of glass at each end, are hung with draperies of crimson damask; there were also handsome pier tables, and large mirrors; a line of glass chandeliers suspended through the centre, with lustres and candelabra of bronze, ornamented *or molu*, were affixed to the pillars lining the sides and ends of the apartment; and portraits, in oil, of the late king and queen, taken in London, were placed, at the upper end, in carved frames richly gilt. In the middle of the room, about sixty feet in front, or two thirds the length of the apartment, the young monarch was seated in an arm chair, spread with a splendid cloak of yellow feathers. His dress was the Windsor uniform, of the first rank, with epaulettes of gold—the present of George IV—and an underdress of white, with silk stockings and pumps. On a sofa, immediately on his right, were Kaakumana, the regent, and the two ex-queens, Kinau—at present the wife of General Kekuanaoa—and Kekauruohe. Being in mourning, they were in well-made, and becoming dresses of black, with ruffs and caps of white. Chairs were furnished for the whole party, which was numerous, including the consuls, resident merchants, visitors, and the mission family.

This interview was not a mere pageant; it was introductory to the delivery of friendly documents from the government of the United States, which were received in the kindest manner, and supported by appropriate presents. The king, although only sixteen, is as graceful, well bred, and perfectly gentleman-like in his whole deportment, as any youth of his age in the most polished circles, and his deportment was marked by great dignity and propriety; his private character is as unexceptionable, as his public appearance is manly and becoming the station he occupies.

Subsequent visits to some of the chiefs evinced that their houses were (according to their stations,) not behind the king in neatness, order, and convenience. The habitation of Kekuanaoa was of this description. He was in England with the late king; there is much of the ease and courteousness of high life in all his movements; and in his manners, figure, dress, and whole deportment, that which would secure to him the epithet of a "gentleman" in any society.

We had, says Mr. Stewart, approached the rear, instead of the front of his establishment; and to reach the principal apartment, or rather house—for every room is a distinct building—were conducted by the chief first through that, which, from a spread table and sideboard, was evidently a dining hall; and then through another with accomodations for sleeping. I by no means regretted this, however, when I perceived the perfect neatness and good taste of each. Had I entered them by accident, without knowing to whom they belonged, I should not have thought of being in the residence of a native, but, from the finish of every part, and from the furniture, I should have supposed myself in the rooms of some foreign gentleman.

The sitting room is delightful. A large door at each end opens a fine draft for the air; the floor was beautifully carpeted with mats; while, in the centre, stood a rich couch of yellow damask, with armed chairs placed on either side, so that those occupying them, enjoyed all the benefit of the breeze sweeping through. On one side, a native lounge or divan extended the whole length of the apartment; spread with a succession of the finest mats beautifully variegated with stained grass, and furnished with round pillars of damask and silk velvet, it looked more tempting to us, on entering from the noon-tide heat of a tropical day, than the Ottomans of more polished drawing rooms would under circumstances of less lassitude. A pier table covered with a rich cloth, a large mirror, and a portrait of Manuia, completed the furniture on that side; on the opposite, a curtain or screen of handsome chintz, looped up a foot or two at the bottom, partially discovered a *boudoir*.

The captain was exceedingly pleased with this specimen of private life; and, for some time, could scarce say any thing, but in admiration of the whole establishment, and in gratulation to our friends, at the comparative luxury of comfort in which they were living. After much pleasant conversation, which I was enabled, with the assistance of Kekuanaoa's English, to interpret, and a glass of wine politely handed by the master of the house himself, (for not a common native was within hearing—a change which you can scarce credit when you think of the dirty, idle throng formerly ever swarming about the houses and visitors of the chiefs) we took leave, saying, that we intended continuing our calls among their compeers. On hearing this, they both exclaimed, "*kakou pu*,"—"*all of us together;*" and the lady taking the arm of the captain, and the general one of mine, we proceeded.

Such is a specimen of the wonderful effects of religious and moral instruction, and of the consequent effects of civilization, in converting, within a few years, hordes of disgusting and profligate barbarians into enlightened, polished, and virtuous people.

Art. IV.—*List of the Plants of Chile; translated from the "Mercurio Chileno," by* W. S. W. Ruschenberger, M. D. U. S. Navy.

(Continued from Vol. XIX, p. 311.)

Chenopodium murale, *C. album*, Linn. and its variety *viride*, common in olitories and fields, and near fences. It is vulgarly called *Quingua*. The *C. Ambrosioides*, *C. anthelminticum* and *multifidum*, Linn. called *Payco*, are also frequent in gardens, near drains, and in sandy situations in the vicinity of torrents. They are frequently employed in medicine, and in fact the penetrating essential oil which they contain leaves no doubt as to their virtues, the principal of which is vermifuge. Apothecaries should extract their essence, which, administered in small doses, produces immediate and salutary effects in children suffering from verminous affections. Steudel, Roemer and Schultes cite in their works the *Chenopodium* and the *Herniaria Payco*, Molina, which are only synonyms of the *C. Ambrosioides* and *multifidum*, Linn. A seed called *Quinua* is employed to give taste to the *Aloja* an agreeable and refreshing drink, when it is not too much aromatised. Not having seen the plant which yields this product, I do not know positively, whether it belongs to the *C. Quinoa*, or to another species of the same genus.

Chironia Chilensis. W. Vulgarly *Cachanlagua*. A plant very frequent on the arid plains of the low grounds, and in the pastures on the hills. It is very much used in this kingdom, and particularly in the country, where it is preserved in packets from year to year. The principal virtue attributed to it is that of *thinning the blood*. My prescribed limits do not allow me to examine in detail the action of the medicine, nor of many others used by the people, who are commonly guided by ancient traditions, and by the blind and gross empiricism of quacks. This point, important to medicine and the country, would be more properly considered in a treatise on indigenous Materia medica. The only observation I may now make, in passing, is that the 'modus operandi' of the bitter principle of the Gentians is sufficiently known to persuade us that *cachanlagua* possesses tonic, stomachic and vermifuge properties, analogous to Peruvian bark, but in a less degree. Sprengel has retained this plant in the genus *Chironia*. Persoon and Steudel in *Erythræa*, Richard. The examination of its capsule, in a state of maturity, authorises me to believe that it should make a part of the latter. Besides, its resemblance to the *lesser Centaury* of Europe, the *E. Centaurium*, Rich., appears to confirm this opinion.

Chlidanthus fragrans. Lindl. A different genus from the *Pancratium L.* with which this plant has been classed by Poiret and Sprengel, (*P. Luteum.*) I have seen it cultivated in gardens, where it is called *ariruma*. Its pleasant odor enhances the value of the species, and it should obtain a place in every flower garden.

Chlorea. Lindl. The species of this genus, of the family of the orchideæ, are sufficiently numerous. It appears they belong exclusively to Chile, but their specific characteristics are very subject to variation, even in the same individual, which has probably contributed to the augmentation of the list. They are found in the stony pastures of the mountains, and in the arid spots near the Cachapual. If it were possible to keep them in gardens, they would produce a fine effect, from the varied shades and the rare elegance of their flowers; then their minutiæ might be sketched, which is necessary, and even indispensable, to show to the public the true representation of the beauties of nature, and to the learned the means of determining, with certainty, plants whose characteristics are materially changed by desiccation, but unfortunately the family of the orchideæ prefers the savage state to the assiduous care of the gardiner, or rather, we should say this branch of cultivation has not yet arrrived at the perfection of others.

Chrysanthemum Indicum. L. This beautiful species and its numerous varieties deserve a distinguished place in gardens, both from the elegance of its flowers and for the diversity of their colors. In autumn, and even in the winter, they decorate the parterres.

Cicer arietinum. L. Pea, Chick-Pea; *Garbanzo.* Cultivated in patches. The consumption of this product might be much more important, and its exportation to neighboring countries, particularly in those years when other crops are scarce, might form a very considerable branch of commerce.

Cichorium Intybus. L. Vulgarly *Achicoria*, is found growing wild, both in cultivated and uncultivated situations. If this and the *Endive*, *C. Endivia*, L. were planted in gardens, two more vegetables would be added to the table, and two more plants for refreshing ptisans.

Cineraria. L. Two fruticose species, the first in the woods on the mountains. It is vulgarly called *Vegua;* the leaves are smooth, somewhat adhesive, sometimes woolly and whitish underneath. The second is found in woods, near the Cachapual. These two shrubs are not of any known use, and it seems that they ought to belong to another genus.

Cissus striata. Ruiz and Pavon. *Pavilla.* It is found in the high woods on the mountains. It mounts the highest trees, and twining round them, reaches to their summit. There is a downy variety.

Citrus Aurantium and *C. Medica.* L. Cultivated trees, known under the names orange and lemon. There are many varieties, some of which are much esteemed, as the *citron* and the *lime.* Since the climate of Chile is favorable to these beautiful trees, it would be well to multiply them, and acquire the good varieties from Europe, which would contribute considerably to the magnificence of large gardens, and yield fruit whose flavor and sweetness are known throughout the world. The tree called the *orange of the Capuchins* or *of Lima*, is probably that which Molina has described, under the appellation of *Citrus Chilensis;* Steudel and Sprengel cite it, but De Candolle has intentionally omitted it. It does not differ from the *C. Aurantium*, except in the small size of all its parts, and particularly of the fruit, which is spherical; the petioles are shorter and scarcely marginate. Otherwise it is the same as *C. Aurantium*, and I believe it is only a variety. There is no indigenous species of *Citrus* in Chile.

Cladonia pyxidata. Spr. On rocks and at the foot of large trees in woods. There are many varieties, one considered as such appears rather to be a different species. The name of *calchacura* is given to all Lichens which grow on trees and rocks.

Clavaria Helvola. Var. *Aurantia*. Pers. (*Myc. Europ.*) A moss which is found on walls and on the sides of drains, in shady and humid situations. I have seen another species on the bark of decayed trees. It is very small, as white as snow, and has a spiral form. It appears new.

Coccoloba sagittifolia, Ortega, is a very common shrub in the plains, on the heights, near roads and other places. It is called *Quilo*. Children eat its ripe fruit, which, though small, is very agreeable. Its root is employed as a medicine, and its wood as fuel.

Cocos Chilensis. Molina. The most majestic tree of Chile, called *Palma de coco*. It is only found at particular points, at the foot of mountains. This palm does not belong to the genus *Cocos* of Linnæus. It differs from the *Jubæa Spectabilis*, H. B. and Kunth, in some well marked characteristics; I have thought that a genus should be made of it, to be dedicated to the memory of the celebrated Molina, a compliment that every Chilian will view with satisfaction, since this author has every right to the gratitude of his countrymen. The different genera which have been dedicated to him, have all been referred by modern botanists to others previously established. The *Molinæa* of Commerson should have been preserved, but M. Ad. Brongniart has followed him and given it the name of *Retanilla*, by which term the species which compose it are designated. I will call it *Molinæa micrococos*, and in time will give its description. I conceive it to be useless to speak of the utility and qualities of this tree, since all are acquainted with its abundant fruit, and the syrup (*miel de palma*) which is used, as also of the several purposes to which it is applicable. The leaves are employed for thatching. Its extraordinary hard and incorruptible wood may afford great resources, since with the trunk (after having removed the center, [pith?] which is not difficult,) may be formed tubes and conduits for water, and sewers, an economical method of replacing those commonly used and whose duration is not so certain.

Colletia. Commers. This genus includes some species very common in this country. The *C. spinosa*, Lamk. (*cruzero, junco marino*,) is known, a shrub which grows on the high grounds near Leona and in other places. The *C. Cruzerillo*, Bertero, is found in the mountains of the same place. It is said that the wood of both these shrubs is purgative. The *trebu* and the *tralhuen* are two other species, which I shall call by the same common names. It is believed that the first possesses vulnerary powers, and an infusion of its bark is employed in cases of internal abscess resulting from blows. The wood of the second is used for turners' work. Boiled in water, it yields a red dye. It is also used for props in high-raised vineyards. The *C. Ephedra*, Vent. known by the name of *frutilla del campo*, abounds in arid situations and on elevations near rivers. It is thus named from the color of its fruit, which at a distance resembles strawberries; it is sometimes white. The thorny species, and particularly the *tribu*, are employed for hedges; the others are useful only as fuel. The genus *Retanilla*, Brongniart, (Mem. sur la famille des Rhamnes,) is composed of two species of the *Colletia* of authors. I think the *tralhuen* might form another, as its fructification is very different. The *Talguenea costata*, Miers, belongs probably to this species.

Colliguaja odorifera. Molina, Colliguay. A pretty shrub; very common on the heights, and in stony and arid situations of the mountains. Sprengel is mistaken in placing it with the genus *Croton;* it differs too much from it, not to be known, even at first sight. It has even some relation to the *Sapium*, as has been already suspected by M. Andr. de Jussieu, in his memoir on the Euphorbiaceæ. Its generic characters are not well known, and until the present period little more has been done than to copy those given by Molina. Its wood is of no use. When burned it yields an agreeable odor. Its milky juice is acrid. It is sometimes used to destroy the nerve in carious teeth.

Colymbœa quadrifaria. Salisb. *Pino* or *Pinon de Arauco.* I have seen it cultivated in some gardens, though not in abundance. Every year the cones and ripe seeds of this tree are received from the Biobio, and are quickly eaten, as they soon become rancid. Why is not its extensive cultivation attempted in favorable soil? It would be admirable to see, in a large garden, the palm and the beautiful pine of Arauco side by side. There would be some to say *our descendants will see them;* and it is certain they would say *our forefathers planted them!*

Conathera bifolia. Ruiz and Pavon. *C. campanulata.* Hook. Very common in dry, stony places on the hills and plains. The last is more common on the heights of Quinta and Taguatagua. The general name of *pajarito* is given to its flowers, and to a great number of others which resemble it only in the color, which is usually blue; but they have no distinguishing names. It might be proper to cultivate both of these species, the last of which might form a new genus.

Condalia microphylla. Cav. A thorny shrub on the arid heights, and among the rocks near Cachapual. It is related to the *Colletia.*

Conium maculatum. L. The *barraco* or cicuta of the country appears to differ, at least in the variety, from that of Europe. It is common in fields and particularly on the sides of roads. Animals do not eat it. It is used as a cataplasm to tumors and in colics.

Convolvulus purpureus. L. In gardens and cultivated enclosures. Its flowers are called *Suspiros*—sighs! This plant, and many other species of the same genus, as well as a great number of species of creeping and climbing plants, the living roots of which should be obtained, are excellent to cover old walls which are offensive to the sight, as they yield only flowers. In pastures and on the sides of roads we meet the *C. arvensis.* L. On the heights and in the enclosures on the hills the *C. Chilensis.* Spr. and the *C. Bonariensis* and *Lasianthus.* Cav. They are indifferently called *correuela.*

Coremium glaucum. Link. A small moss which grows on half rotten apples, pears and other fruits.

Cucumis sativus. L. *Pepino*, cucumber cultivated in the fields. It is eaten in salad, and pickled in vinegar which is what the French call *cornichons*—gherkins? The *Melon.* C. Melo. L. many varieties of which are distinguished only by their color, are abundant in Chile, and commonly possess an exquisite taste. The fruit, which is called the *melon de olor*, and which is cultivated in fields and gardens, appears to me to be a variety of the *C. Melo*, if it is not the *C. deliciosus.* Roth. These melons, generally small and spherical, sometimes acquire a considerable size with various forms. They are not edible, but the pleasant odor which they exhale renders them agreeable. They are sometimes placed in clothes-presses in order to communicate their perfume to the clothes. The *C. Citrullus.* Ser. (*in*

D. C. prodr.) is the most extensively used fruit of the country. It is called *zandia—watermelon*; it is wholesome, very juicy and sometimes very sweet, and is delightful in the country, where there is an incredible consumption of it. There are many varieties; one of them is late, and has the additional merit of being kept with facility until the winter season.

Cucurbita Lagenaria. L. (*Lagenaria vulgaris*. Ser. C. c.) Vulgarly *calabaza*—calabash. The fruit well ripened is used as a ladle. Some are very large, and of different figures, upon which the name given them often depends. The *Acayota* and *Zapallo*—pumpkin, are the most frequent species. They are cultivated in olitories and in fields. The first is employed almost exclusively for making sweet-meats; the second is an excellent aliment and may be preserved throughout the year. There are *zapallos* abounding so much in saccharine matter, that it would be difficult to distinguish them by the taste from the *batata dulce*—sweet potatoe—(*Convolvulus Batatas*. L.) the root of which is brought from Lima and is known under the name of *Camote*. Attempts have been made to cultivate it in this country. The *C. Siceraria* and *C. mammeata* Molina are referred to these two species, and I doubt if they can be separated from the *C. maxima*, Duch. *Melopepo*, and *Pepo*, L. I have not found them wild in this country.

Cupressus. A tree cultivated in some gardens. A sad decoration for a place of amusement; it would be more appropriate near the funereal marble, on a peaceful and solitary mountain. The name *cypress* is given to this tree, to a *Thuia*, which is also cultivated, and to a tree of this country which I have not yet seen. The wood of the last is that which is most used.

Cuscuta Chilensis. Ker. A wild plant which is nevertheless called *angel's hair—cabello de angel*. It is very injurious to meadows and vineyards. I have seen it cover trees to the very top. The means of its destruction should be sought for. There are two species, if the sessile and pedicellate flowers are a constant character.

Cydonia vulgaris. Pers. A cultivated tree; there are two varieties, the *membrillo* and the *lucuma*. The fruit in sweetmeat is good and, in fact, has no other use. The twigs of these trees are manufactured into baskets. This *lucuma* must not be confounded with that of Coquimbo, a genus so called by Jussieu, and of which I will speak in the proper place. The genus *Lucuma*, Molina, should be abolished, in as much as it is composed of heterogeneous species which belong to other genera.

Cynara Carduncculus. L. It would be difficult to persuade an inhabitant of the country in Chile, that the artichoke, *cardo*, is a plant of the old continent. In reply they would point to its extensive cultivation, which occupies half the soil. In fact it is impossible to believe this, until after traveling for leagues amidst great quantities of this plant which flourishes here in an astonishing degree. The leaves afford aliment to their flocks, but they eat them however, only when other food is scarce. The people of the country are very fond of the foot stalks when they are tender. Many prefer the stalk itself in the same state, the amount of the consumption of which, during the spring, is almost incredible. Notwithstanding this, I am persuaded that its extermination is desirable, which will be difficult from the depth of its roots. The following method might be tried. Let the stalks be cut down during the flowering season, by which its propagation by seed will be prevented. It would be well to cultivate this plant in given quantities in olitories; to guard it well and store it in the earth for winter, and thus secure an excellent vegetable, suitable for the most elegant and refined table. The *C. Scolymus.* L. a variety of the first according to Sprengel, vulgarly *alcachofa*, is not much propagated. A country like this should have excellent artichokes, i. e. *alcachofas*, and in large quantities.

Cynoglossum lateriflorum. Lamk. and *C. pauciflorum.* Ruiz and Pavon. Two small plants, common in pastures near rivers. The last is also found on the hills.

Cyperus. L. Two species; one in drains, and wet meadows, vulgarly called *vareta de San José*, St. Joseph's rod, the other smaller, resembles the *C. flavescens.* L. which grows in the marshy situations about the lakes of Aculeo and Taguatagua.

Cytisus sessilifolius. L. A shrub of Europe cultivated in some gardens. It would be better in landscape woods.

Dacryomyces albidus. Bertero. A small and beautiful moss, which grows on the trunks of fallen and half rotten trees. It differs in color and other characteristics from the *D. stillatus.* Nees. which also I have found.

Danthonia antarctica. Spr. A rare grass in the arid and mountain pastures, near the Cachapual, running towards Cauguenes.

Datura arborea. L. Cultivated in gardens for the beauty and fragrance of its flowers. The *floripondio* is easily multiplied, particularly in a climate like this, where it may pass the winter in the open air. The *D. Tatula.* L. (*chamico*) is very common near dwellings, in deserted gardens, and along torrents. There is a variety with very large flowers of a clear blue color and another with small white flowers. The sad aspect of the plant and the disagreeable odor which it exhales indicate its noxious qualities. It is employed externally in certain complaints.

Daucus Carota. L. *Zanahoria, carrot,* of the gardens. Its use is not so extensive as it should be. It is frequently met with near woods, in meadows where there are trees. The *D. Montevidensis.* Link. has no common name.

Delphinium Ajacis. L. An interesting plant from the prodigious number of varieties cultivated in gardens. It is one of those which bears the name of *pajarito.* If it is not well taken care of it soon degenerates, becomes simple and is only an ordinary flower.

Dematium fimbriatum. Schwein. A very small moss which is met with on the dead and rotten branches of cherry and plum trees.

Dyanthus Caryophyllus and *D. Chinensis, L. Claveles,* pinks, these two are the only species cultivated in gardens. The numerous and beautiful varieties of the first are little known. Those which are met with are not remarkable. In order to possess good pinks, much care is required in sowing the seed which has been obtained by crossing the different colors. It would be desirable to propagate here good collections of pinks, particularly for the use of the fair sex whose admiration for flowers is known.

Dichondra sericea. Sw. A small plant which is seen by the sides of roads and in the stony pastures on the hills. It is perhaps the same which Miers has named the *D. repanda.*

Dimorphopetalum Tetilla. Bertero. A new genus of the family of Oxalides: this pretty plant is met with in stony situations, and in the clefts of rocks. The petiole is notched at its base, and full of an acrid sweet juice, which children take pleasure in sucking. The vulgar name, *tetilla,** given to this plant designates with sufficient clearness the form of the part which is eaten, though the resemblance is not exact.

Dioscorea variifolia. Bertero. Common in pastures, on the hills, and in thickets. I do not know whether it is the same species as the *D. Hederacea.* Miers; all I can say is, that it does not resemble the ivy in any particular, either in its leaves or its size. The leaves are sometimes cordate, sometimes sagittate and sometimes linear in the same individual. The flowers are dioecious.

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* A little dug

Diplandra Potamogeton. Bertero. This plant, the most interesting which I have met with, grows in the clear waters of the drains of Quinta, Corcolen and Taguatagua, and resembles a *Potamogeton* so closely that it can be distinguished only by its flower. It is dioecious; the calyx tubular, very large, and the tube of the corolla more elongated, the anthers are twelve, and are inserted into the throat of the corolla, at the top of the tube. After fecundation, they are dilated and take the form of a *petaloid* membrane. It is doubtless a new genus, and should be added to the family of the Naïades.

Dipsacus Fullonum, *L. Carda*, common on the banks of drains and in humid spots on the plain. This plant has but little use at present, nor will it be an object of speculation until manufactories of cloth are established, which will not be until after the propagation of the Merino sheep, which ought to do well in many parts of the territory of Chile.

Dolichos biflorus, and *D. sesquipedalis*, L. are plants very little cultivated. The first should draw the particular attention of cultivators who would have another vegetable at their disposal in a country where this species of pulse is in general use. Its legumes, when they are tender, form a delicate dish, and may be preserved throughout the year by salt, in well stopped jars, thus securing an excellent resource in winter. The plant which is cultivated in gardens under the name of *ramilette*—nosegay—is without doubt the *D. lignosus*, L. It is probable that Molina has described the same species, to which he has given the name of *D. funarius*. The *D. ruber*, Jacq. (*Dioclea Jacquiniana*. D. C. *Hymenospron rubrum*. Spr.) is also cultivated in some gardens, and is called *enredadera*, a very vague appellation and applicable to an infinity of plants whose stalks interlace with the neighboring plants. The same use may be made of these two last species as was spoken of under the head of *Convolvulus*.

Donatia. Forst. Common on arid heights and on the sides of torrents. This very singular and pretty plant has no vulgar name. De Candolle places the *Donatia* in the family of the Paronychiæ, (*Prodr*. Vol. III, p. 351,) though he does not mention it among those he describes in that place. Was it overlooked?

Dothidea Sphærioides. Fries. A very small moss common on the bark of the *Populus dilatata*, Ait. *alámo*, poplar, principally on the dead and half rotten branches.

Drymis Chilensis. D. C. This tree known by the name of *Canelo*—cinnamon tree—is nearly related to the *D. Winteri*, Forst. and it appears to me difficult to separate it since the characters assigned to it are not constant. In fact, the height of its trunk varies much; some are very high. I have met with it in humid places on the plains, and in the woods on the mountains. Its peduncles are sometimes simple and sometimes umbellate. The number of petals also varies in the same cluster. The *Canelo* is the sacred tree of the Indians, for their assemblies and religious ceremonies, in which they invoke *Pillaū*. They employ it for different superstitious uses, and it is an ingredient in the greater part of their medicines. The fresh wood is tough and dry, and it is hard, and proper for works which are not exposed to water. Joists are made of it; it preserves clothes from insects; when burned, it exhales a smoke offensive to the eyes, but of a pleasant smell. Its bark is employed as a medicine: its decoction restores the color of indigo and fixes it; mixed with salt and urine it kills the insects which infest animals. It is administered in scaly eruptions, and it is considered a detergent in malignant ulcers. The properties of the winter's bark being known, we can have no doubt of those possessed by this tree.

Duvaua dependens. D. C. A small shrub four or five yards high, known under the name *Huingan*, common in woods at the foot of hills. The infusion of the seed is stomachic. It is exhibited in hysterical and urinary affections, and in the principal of the hydropic diseases when the type allows its use. From this tree exudes a resin, which, spread on paper, is applied as a specific against pains and tension of the muscles and tendons, as well as for diseases from cold. The decoction of its bark yields a balsamic, vulnerary essence, useful in the pains of gout and coldness of the feet. Its seed is used in the drink called *chicha*, which is agreeable but too strong. The *Schinus Huigan*, Molina, cited by all modern botanists, belongs to the *D. dependens,* and should be referred to this species. The *Molle* as we have already said, is probably a species of *Amyris* or a new species of *Duvaua*.

Eccremocarpus Sepium. Bertero. I will add to what I have already said, that this plant differs considerably from the *E. longiflorus*. Humb. and Bonpl. I am convinced of this, by a comparison made with the drawing given by those authors, (*Plant. Æq.* 1. *tab.* 65.)

Eclipta erecta. L. In the inclosures, around the lake of Aculéo. It resembles the *E. palustris*. Forst.

Elatine tripetala. Smith. In the roads and oozy places of the plains and hills. The number of the petals and stamina is subject to variation.

Elymus. L. A grass which grows in humid situations on the plains and hills. It is called by some cola de raton, rat's tail, a name common to several plants of the same family.

Ephedra Americana. Humb. A small shrub which delights in stony, craggy situations among the rocks, and hills, and the mountains. The *E. bracteata*, Miers, is perhaps the same.

Epilobium. L. Two species related to the *E. alpinum* and *tetragonum.* L. They grow in the drains, and humid and sandy places, near torrents, in Taguatagua and Aculéo.

Equisetum Bogotense. H. B. and Kunth. On the sides of drains, near rivers, in sandy and humid situations. It is called *yerba de plata*—silver grass, because it serves to clean tarnished silver. Its root is employed as a diuretic.

Erigeron. L. Four species, of which one is probably new, the *E. Canadensis*, L. the other two resemble the *E. Bonariensis.* L. All these plants grow in inclosures, gardens, and fields, on the sides of roads, and in the dry pastures of the plain.

Erineum Vitis. Pers. Generally known by the name of *peste.* It attacks the leaves of the vine, and in some places extends itself in an almost incredible manner. I have found another species which I have called *E. Mayteni.* It grows on the under surface of the leaves of the *Mayten.*

Eriosporangium Baccharidis. Bertero. A small moss which grows on the branches of the rosemary; it produces furrowed nodosities, filled with woolly filaments, which shed a yellow dust similar to the pollen of flowers.

Erodium. L. The species of this genus bear the name of *alfilerillo.* The *E. moschatum*, Ait. is very common in the meadows, and especially in those of the mountains; it smells like musk and communicates its own odor to the animals that eat it. It is an excellent forage. The *E. Cicutarium*, Smith, and the variety *B.* D. C. *prodr.* are very frequent in meadows, in sandy situations, near rivers, and on the hills. I have met in the stony places along the Cachapual, with an *Erodium*, which resembles the *E. Malachoides*, Willd.

Ervum Lens. L. Vulgarly *lenteja*—lentil—sown in fields. As regards the cultivation of this plant, and the consumption of it, we will refer to the article *Cicer Arietinum;* what has been said there is here equally applicable.

Eryngium. L. The name *cardoncilla* is given to the *E. paniculatum*, De Larbr. which grows on heights, near crags: I have met with two other species: one in the marshes in the suburbs of Santiago, which appears to be the *rostratum*, Cav. the other in the sandy meadows along the Cachapual going to Cauquenes. This last is probably new.

Erythrina. L.*

Escallonia. Mutis. Three species are known: the *ñipa* (*E. rubra*, Pers.) and Corontilla, (*E. resinosa*, Pers.) These two trees grow in the woods on the hills. The last is very pretty when in flower. The racemes, hard and almost cylindrical, resemble a small ear of corn, and hence the vulgar name. It would look well in gardens. I have seen a variety with velvety leaves on the heights of Taguatagua. The wood is useful for some kinds of work, but it is not much appreciated. The leaves are employed in medicine, for baths and vapors. The *lun* (*E. thyrsoidea.* Bertero,) grows in woods near rivers. Its wood is solid, though it is not used. Its bark is purgative.

Eupatorium. L. Two species of this genus: the first is a shrub, common in the woods of the hills; it approaches the *E. lævigatum.* Lam. It is called *salvia*, and its leaves are used in certain cases. The second is common in breaks, and the sides of woods in the mountains. I call it *E. Chilense.* It is proper to remark that the *E. Chilense*, Molina, is only a synonym of the *Flaveria Contrajerva.* Pers.

Euphorbia Lathyris. L. Vulgarly, *tártaro contrarayo;* a plant of Europe which is not rare in gardens. It is a powerful drastic, and should be exhibited only with the greatest precaution. The *pichsa* (*E. Sepyllifolia.* L.) is indigenous, and grows on the sides of roads and fields in sandy situations. It is employed as a purgative. Its infusion is given in certain urinary affections.

Exacum Chilense. Bertero. A beautiful and small plant, very abundant in the meadows, near rivers, and on the hills. It resembles the *E. pusillum*, D. C. and *quadrangulare.* Willd.

To be continued.

* I met by chance with a branch belonging to a species of this genus. It was loaded with flowers, and appeared to be recently torn from the tree. The leaves and petioles were armed with thorns as was also the branch. It is cultivated in a garden in the capital. I have searched for it in vain. Having seen it only *en passant*, it was impossible to determine it. I think, however, it is originally from Mexico, whence the seed has been brought. The elegance and color of the flower make it worthy of a place in flower gardens. Since the climate of Santiago does not prevent its culture, I would advise the owner of the tree to sow the seeds or divide them among amateurs.—B.

Art. V.—*Meteorological Tables.*—1. By Gen. Martin Field.

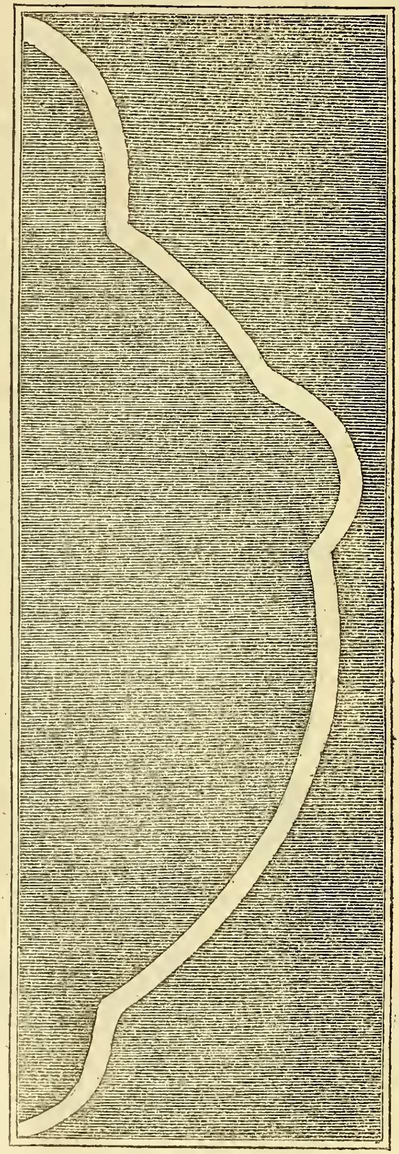
Extracted from a Journal of Observations, made at Fayetteville, (Vt.) from the 30th day of April, 1830, to the 1st day of May, 1831, in lat. 42° 58′ N. and lon. 4° 20′ E. from Washington.

1830 and 1831.	THERMOMETER.											WEATHER.				WINDS.								MISCELLANEOUS.					
					Maximum of temperature.			Minimum of temperature.				No. of days of diff. variation.																	
M'ths.	Mean temp. at sun rise.	Mean temp. at 2 o'clock, P. M.	Mean temp. at 9 o'clock, P. M.	Aggreg. of mean temp. each month.	Day.	Hour.	Highest degree.	Day.	Hour.	Lowest degree.	Range of Therm'r	Fair.	Cloudy.	Rainy.	Snow & hail.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Inches of water in rain, snow & hail in day time.	Inches of water in rain, snow & hail at night.	Aggregate of water each month.	Inches of snow & hail.	Lightning & thunder. No. of days.	Aurora Borealis.
May	42.8	65.	52.	53.3	1	2 P. M.	76°	23	5 A. M.	26°	50°	23	8	3	0	5	1	—	2	9	3	4	7	-.8	2.-	2.8	—	1	8
June	53.3	71.	59.6	61.3	15	3 .	82	1	4 .	44	38	19	11	9	0	—	3	1	2	7	5	5	7	4.8	1.9	6.7	—	6	3
July	60.6	77.4	67.2	68.4	21	.	94	10	.	43	51	20	11	8	0	—	4	3	3	3	4	5	9	3.5	1.8	5.3	—	7	1
Aug.	58.	73.7	65.	65.6	7	2 .	86	19	5 .	46	40	21	10	6	0	1	1	—	2	8	4	2	13	1.2	2.1	3.3	—	6	4
Sept.	48.6	66.6	54.	56.4	25	.	76	30	6 .	26	50	22	8	4	0	2	5	1	—	9	2	2	9	1.4	1.-	2.4	—	—	4
Oct.	38.1	57.7	44.5	46.7	2	.	70	26	.	20	50	20	11	7	0	2	2	4	1	5	6	2	9	-.7	3.-	3.7	—	3	6
Nov.	38.3	47.8	39.1	41.7	1	.	66	21	7 .	25	41	14	16	4	2	1	6	5	2	—	2	3	11	4.-	4.-	8.-	13.-	—	4
Dec.	26.1	33.3	27.6	29.	26	3 .	44	22	8 .	-12	56	15	16	3	2	1	6	1	2	6	4	3	8	1.3	4.8	6.1	3.-	—	5
Jan.	10.4	21.	15.2	15.5	5	2 .	43	21	.	- 8	51	21	10	2	3	5	2	—	—	2	3	3	16	1.2	2.-	3.2	18.-	—	4
Feb.	10.4	25.6	16.6	17.5	28	.	38	14	.	-10	48	23	5	1	4	—	2	—	1	3	1	3	18	1.8	2.3	4.1	23.-	—	5
March	29.	43.6	33.5	35.4	31	.	64	18	6 .	15	49	19	12	1	5	—	1	1	3	3	7	6	10	1.9	3.3	5.2	11.-	1	6
April	39.	53.6	43.8	45.5	15	3 .	66	12	5 .	26	40	18	12	6	0	3	4	1	4	3	3	5	7	3.9	3.8	7.7	—	—	6
Ag.tem	37.9	53.1	43.1	44.7	*Recapitulation.*							235	130	54	16	20	37	17	22	58	44	43	124	26.5	32.-	58.5	68.-	24	56

Remarks.—From the foregoing table it appears, that the mean temperature of the year was 44° 7′, which was 5′ warmer than the two years preceding. The temperature of the summer months was 65° 1′; that of the winter months 20° 7′—difference 44° 4′. The highest temperature within the year was on the 21st of July, and was 94°; the lowest, on the 22d of Dec., and was 12° below zero. Range of thermometer, 106°. The temperature was above 90° on four days in the month of July, and fell below 0 eleven nights during the winter. From the 5th of January to the 15th of February, (being forty-one days) the temperature at no time rose above 28°. We had sixty-eight inches of snow and hail during the winter, which is much less than usual in Vermont; and we had no sleighing till the first of February, and it went off about the first of March. The quantity of water which fell in rain, hail, and snow, was 58.5 inches, which was 22.4 inches more than fell during the twelve months preceding.—Vegetation was unusually forward the last spring, and fruit trees were in full blossom about the first of May. But afterwards, within that month, we had eleven severe frosts, which destroyed all the fruit in the vallies, and on the low grounds throughout this part of the country. But the summer months were favorable for vegetation, and most of the crops were abundant.

On examining my meteorological journal, which I have kept for many years, I find that the occurrence of the aurora borealis has varied from ten to twenty eight nights, when I have noticed it in different years; and that for ten years, previous to the last, the average number of evenings when it has been seen, is eighteen, annually. But within the last twelve months the aurora has been visible on fifty six nights, which is twice the number of any former year of which I have any record. During the year past, it has exhibited many interesting appearances, two of which I shall briefly notice. The first occurred on the evening of the 14th of July.—The afternoon of that day was showery, with lightning and thunder; but the evening was clear, except a black cloud low down in the north. The thermometer stood at 62°, and we had light breezes from the west. As soon as the day light closed, the aurora borealis appeared above the dark cloud in the north—and immediately it shot up in streams of diverging rays of light towards the zenith. These streams of rays would accumulate and dissolve in rapid succession, and at 10 o'clock the onrthern part of the heavens was brilliantly illuminated. At half past ten an arch of yellowish white light appeared in the north about 30° above the horizon, which moved towards the south, with a gradual and equal motion, absorbing in its course all those streams of diverging rays before mentioned. At half past eleven the arch passed the zenith exhibiting a broad and luminous band in the heavens, which extended to the horizon on the east and west, and was studded with stars, which were visible through it. After passing the zenith a few degrees, the arch broke up into columns, which gradually disappeared as they passed off to the south. This arch very much resembled that which occurred on the evening of the 28th of August, 1827, except that the light did not present the waving motion which was then exhibited. The dark cloud in the north, and the aurora, continued through the night. The day following was rainy, attended with vivid lightning and heavy thunder.

The next appearance of the aurora borealis which I shall notice, occured on the evening of the 9th of March. There was nothing unusual in the appearance of the aurora on that evening except the form of the arch, and that was such as I never before witnessed, nor am I able to explain the cause. There was no moon at the time—the sky was clear—and the stars brilliant. The wind had blown from the south during the day, but the evening was unusually calm. The thermometer stood at 26°. Early on that evening, streams of light shot up in the north as usual, but were principally confined near the horizon. At half past 8 o'clock a bright arch was formed which rose to the height of about 40°. It was well defined, and extended to the horizon on the east and west. This arch exhibited the appearance of segments or sections of circles, of different diameters, all of which were perfectly united. This appearance continued about fifteen minutes, when the arch became broken into sections, and gradually disappeared. The following diagram which I made at the time, will afford a tolerable idea of the form of the arch during its continuance.



In conclusion I would remark, that so far as I have observed, the aurora borealis generally occurs in calm weather, and in summer it is almost universally the precursor of thunder storms, and in winter, of snow and boisterous weather.

Fayetteville. Vt. May 2d, 1831.

2. *Thermometrical Register for ten years; kept in Boston, (Mass.); Lat. 42° 21′ N.; Long. 71° 4′ W. from Greenwich.*

Hours of observation, 7 A. M.; 2 and 9 P. M.

Years.	Jan'y.	Feb'y.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Years.
1820	22.88	31.09	35.27	44.94	55.19	66.40	75.34	70.29	64.71	50.11	37.75	26.52	48.37
1821	20.58	32.53	34.03	43.58	56.03	66.52	68.22	71.50	63.24	50.24	40.64	29.26	48.03
1822	23.28	28.30	38.70	45.15	61.37	66.72	72.92	68.16	66.47	52.23	44.25	30.27	49.82
1823	26.72	22.71	33.57	46.68	53.76	65.09	70.87	70.45	58.85	50.17	36.41	32.54	47.32
1824	30.30	29.31	35.76	47.76	55.12	64.94	71.26	67.20	62.91	51.79	39.83	34.73	49.24
1825	28.70	31.31	40.04	48.77	56.98	69.82	77.61	69.44	60.18	53.11	39.76	32.54	50.69
1826	29.02	30.92	36.60	43.56	63.59	67.96	72.92	69.87	64.56	51.87	40.62	32.28	50.31
1827	22.64	28.95	37.38	50.33	56.90	66.01	71.76	68.97	62.54	52.99	34.99	32.01	48.79
1828	31.91	37.51	37.69	44.19	56.90	70.10	73.58	74.09	64.32	51.05	43.67	36.29	51.78
1829	26.23	23.11	32.33	46.40	59.88	66.50	69.64	68.96	58.26	49.97	40.78	37.40	48.29
Mean.	26.23	29·57	36.14	46.13	57.57	67.00	72.41	69.89	62.60	51.35	39.87	32.38	49.26

Lowest, January 25th, 1821; and February 1st, 1826—12° below zero.
Highest, July 11th and 12th, 1825—102°

ART. VI.—*On the Achromatic Microscope; for the Journal of Science*, by EDWARD THOMAS.

IN a former article on improvements in the microscope, published in Vol. XIX. of the Journal of Science, a description was given of the best form of the achromatic microscope then adopted. Material improvements have since been made, which it is the object of this paper to explain. Many of these have been introduced by Alden Allen.

When a lens is required with a focal distance of an inch or more, and is to be used as a simple microscope, one single lens of plate glass, having its radii nearly as 1 to 6, will exhibit objects about as distinctly as one of any other construction. But when the focal distance is half an inch or less, an achromatic lens is superior, whether for simple or compound microscopes. The form represented in Fig. 1, is the best for simple microscopes, when the focal distance is from one half to one fourth of an inch. If a shorter focal distance be required, and a large aperture is necessary, it will be most advantageous to employ the sextuple achromatic shown in Fig. 2.

In Fig. 1, is shown the best form of the object glass of a compound microscope, when an aperture is required nearly equal to one half of the focal distance: *a* is the first surface, *b* the last, and o the place of the object to be viewed. The following are the dimensions and radii.*

			Inch.	
Radius of the	1st	surface,	0.15	plate.
do.	2d	do.	0.20	
do.	3d	do.	0.15	flint.
do.	4th	do.	0.15	
do.	5th	do.	0.15	plate.
do.	6th	do.	0.20	

Focus of the compound lens, 0.27
Diameter, ... 0.14
Clear aperture, . . 0.10 to 0.12

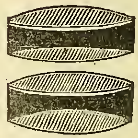
Fig. 1.

* The figures are all drawn four times the real size.

Fig. 2 represents the best form of the sextuple object glass, and is to be used when an aperture nearly as great as the focal distance is requisite. The superiority which this form of the sextuple lens possesses over the one formerly described, consists in its greater simplicity, having a less variety of curves; in its affording a greater field of distinct vision; and in a greater freedom from secondary aberration of figure, when the aperture in each bears the same proportion to the focal distance. It is also practically free from spherical aberration, both when the tube of the microscope is lengthened and when it is shortened.* These advantages more than compensate for the loss of light, caused by a greater number of reflecting surfaces.† The following are its dimensions and radii.

			Inch.	
Radius of the	1st	surface,	0.19	plate.
do.	2d	do.	0.267	
do.	3d	do.	0.20	flint.
do.	4th	do.	0.20	
do.	5th	do.	0.20	plate.
do.	6th	do.	0.267	
do.	7th	do.	0.15	plate.
do.	8th	do.	0.20	
do.	9th	do.	0.15	flint.
do.	10th	do.	0.15	
do.	11th	do.	0.15	plate.
do.	12th	do.	0.20	

Fig. 2.



Focus of the compound lens, 0.17
Diameter, ... 0.15
Clear aperture, . . 0.13 to 0.15

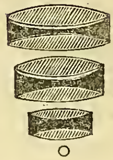
Fig. 3 exhibits the form of the microscope to be adopted when an aperture greater than the focal distance is necessary. It consists of nine lenses, of which six are plate glass and three flint glass. The following are the dimensions and radii.

* The former sextuple combination was free from spherical aberration, only when the tube was extended to a certain length.

† All the surfaces in contact are cemented in each of the three combinations.

			Inch.	
Radius of the	1st	surface,	0.16	plate.
do.	2d	do.	0.23	
do.	3d	do.	0.16	flint.
do.	4th	do.	0.24	
do.	5th	do.	0.24	plate.
do.	6th	do.	0.23	
do.	7th	do.	0.12	plate.
do.	8th	do.	0.155	
do.	9th	do.	0.12	flint.
do.	10th	do.	0.18	
do.	11th	do.	0.18	plate.
do.	12th	do.	0.155	
do.	13th	do.	0.09	plate.
do.	14th	do.	0.08	
do.	15th	do.	0.08	flint.
do.	16th	do.	0.12	
do.	17th	do.	0.12	plate.
do.	18th	do.	0.09	
Focus of the compound lens,			0.102	
Diameter of the	1st set		0.14	
do.	2d "		0.12	
do.	3d "		0.08	
Clear aperture,			0.12 to 0.14	

Fig. 3.



Each of the three kinds shown in the figures has been constructed and found to perform well. The convex lenses of the object glass shown in Fig. 3, should be made as thin as is practicable, that the focus of the microscope may be as far as possible from the last surface. The thickness of the flint lenses at their centres may be about $\frac{1}{100}$ of an inch. If they are much thinner they will bend and become disfigured while polishing.

The lenses of the object glass of an achromatic microscope must be centred with great accuracy; and they may be considered as well centred, when their optical centres do not vary from a right line more than $\frac{1}{1000}$ of an inch.

Flint glass is preferable which has the greatest dispersive ratio; for the secondary aberration of figure is less, when the aperture is the same in relation to the focal distance; although it is greater, when the aperture is the same in relation to the first radius of the flint lens.

The tube of the microscope should be made of variable length. When the sextuple object glass is used, the length may be made to vary from four to six and a half inches. The microscope will then magnify the diameter, with a proper eye-piece, from ninety to one hundred and eighty times. When the length is so adjusted as to make it magnify the diameter one hundred times, the vision is so distinct that objects are rendered visible, which cannot be seen with *any single glass lens.*

In constructing achromatic microscopes, it is very difficult to make them free from spherical aberration in the first attempt, even when we know with precision the required radii and thickness of the lenses; as a small variation in either will materially affect the spherical aberration. It is therefore found expedient not to rely on theoretical calculations, but to ascertain by direct experiment, the radii that will destroy, most effectually, the color and spherical aberration in glass of a given density. When a standard microscope is thus obtained, and several similar ones are required, the most practicable method appears to be, to construct them as nearly similar as can easily be done, and then change one of the curves of the first lens, until by approximation, the spherical aberration be nearly corrected. When this is done, the correction may be completed by changing the size of the aperture, enlarging it when the aberration of the convex lens is greater than that of the concave, and diminishing when less. The correction may also be completed, when the aberration of the concave is less than that of the convex, by grinding the edges of the flint lens on a flat hone, so as to bring its centre and the uncemented convex lens nearer together. No correction could be made by changing the aperture, if no secondary aberration of figure existed; but in consequence of the great increase of this aberration with the increase of aperture,* on the one hand,—and the insufficiency of a great reduction, (especially if the aperture be small,) to correct the spherical aberration, on the other,—the extent of this mode of correction is necessarily limited. It must, therefore, be first nearly corrected by changing one or both of the radii of the first lens. As these changes are small, they will not much affect the secondary color.

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* It appears from calculation, that the longitudinal secondary aberration of figure, in microscopes of *large* apertures, increases nearly as the fifth powers of the apertures; and that when the apertures are *very large*, it increases in a still greater ratio.

When ordinary plate glass is used with flint glass whose specific gravity is 3.45, the radii previously given may be taken as the standard. If the density be 3.50, the first radius should be changed in the triple object glass, from 0.15 to about 0.14, applying the other radii, as there given, for a standard. The plate glass used had a refractive power of 1.514.

In order to obtain the best forms for microscopes, it appears necessary to make those radii which are situated at nearly the same distance from the focus of the microscope, as nearly equal as possible, and at the same time correct the color and spherical aberration,—as indistinct vision caused by secondary aberration of figure, will be produced, if the diameter of the pencil of light be too great in proportion to the radius of the surface through which it passes. Thus in a triple microscope, having a double-concave flint glass whose radii are equal, an aperture much greater than four fifths of the shortest radius in the microscope, (even if its focal distance were made very short,) cannot be advantageously used, especially if the first concave surface has a radius as short as any in the microscope.

It is believed a microscope might be made more powerful than any hitherto used, by substituting sapphire or some other substance of similar optical properties for plate glass; and using flint glass of great density. This would enable us to diminish the focal length in relation to the aperture, and thus increase the power.

Greatfield, Cayuga County, N. Y. May, 1831.

Art. VII.—*Considerations on the employment of Sulphate of Copper, and of various other saline materials in the making of Bread, presented to the board of Health of the department du Nord,* (*April*, 1830); by M. Kuhlmann.

(Abridged from the Annales de L'Industrie; by J. Griscom.)

Being frequently called upon by the tribunals to undertake the chemical examination of bread, suspected to contain substances injurious to health, the author obtained a variety of facts relative to this kind of adulteration, which he has deemed it right to exhibit, in order that those who may be occupied with such examinations, may be saved the trouble of numerous trials, and that the public authorities may direct their attention to a matter which so much concerns the general welfare.

The author divides his essay into two parts; in the *first* he treats of the origin of the use of those materials which are employed in adulterations, of the proportions of them which have been adopted by bakers, of the effects they produce, and of the methods he has found most effectual for detecting their presence, even in minimum quantities;—in the *second*, he determines the action which these different substances exert upon the quality of bread. This was effected by baking a very great number of loaves with variable proportions of the adulterating materials.

PART FIRST.

The north of France and Belgium has been for some time past the principal theatre of frauds committed by bakers, by the mixing of sulphate of copper with their bread. The practice appears to have commenced about 1816 and 1817, in which years the grain was generally of a bad quality. To obviate this inconvenience, they mixed with the wheat flour, the flour of dry beans and other substances, and at length made use of blue vitriol, finding that it contributed to hasten the fermentation, to cause the dough to retain more water, to diminish the labor of kneading, and produce a lighter and finer looking bread from the defective or the mixed flour.* The abuse was afterwards carried to such an extent, that in some of the towns, commissioners were chosen to have the permanent supervision of the bread made and sold by bakers.

If the detection and punishment of so serious a crime as the poisoning of bread is a matter of importance to the public welfare, it is also very necessary to be able clearly to demonstrate the presence of the poisonous material. The detection of copper in bread would seem to present no difficulty, as this metal manifests its presence by decisive chemical characters. The contact of sulphuretted hydrogen, hydro-ferrocyanate of potash, or ammoniacal gas, may remove all uncertainty; but when it is considered in how small a proportion this poisonous salt is employed, these experiments demand the most careful attention. Prussiate of potash indeed will indicate the presence of one part of sulphate in nine thousand parts of white bread, by the production of a rose color in the containing fluid. The author obtained the following results.

* Thirteen bakers were condemned on the 27th of January, 1829, by the correctional tribunal of Brussels, for mixing sulphate of copper with their bread.

No.	Quantity of sulph. of copper in bread.	Action of ferrocyanate of potash.	Action of hydro-sulphate of ammonia.
1	$\frac{1}{29000}$	. .	. .
2	$\frac{1}{15300}$	. .	. .
3	$\frac{1}{8700}$	Very apparent rose color.	. .
4	$\frac{1}{7360}$	A deeper rose color.	. .
5	$\frac{1}{3590}$	Blood red.	Brownish color.
6	$\frac{1}{1875}$	Crimson (deep.)	Apparent brown.

It is obvious that hydro-sulphate of ammonia is much less decisive than the ferrocyanate of potash. Liquid ammonia produces a sensible blue color by contact with bread, only when the sulphate of copper is in such quantity as to occasion a green color in the bread.

The author considers the ferrocyanate of potash as a test sufficiently delicate to shew the presence of copper in quantities injurious to health; but to determine its existence in the smallest quantities, the method which he prefers is to burn in a platina capsule two hundred grammes of the bread to be examined, reduce the cinders to fine powder; mix this with eight or ten grammes of nitric acid; heat the mixture till the free acid is evaporated, dilute the pasty mass with distilled water aided by heat, filter, add a small excess of liquid ammonia and a few drops of a solution of sub-carbonate of ammonia. When cold, filter again, heat to ebullition so as to expel the excess of ammonia, and until the fluid is reduced to a fourth of its volume. This fluid, acidified by a drop of nitric acid, is divided into two parts; to one is added hydro-ferrocyanate of potash; to the other hydro-sulphuric acid or hydro-sulphate of ammonia. This process, says the author, if punctually followed, will shew, by the first of these tests, the presence of one part of sulphate of copper in 70,000 of bread, by the immediate production of a rose color, and a light crimson precipitate after a few hours' repose. The hydro-sulphate produces a light fallow color, and a brown precipitate. If the copper exist in greater quantity, a polished blade of iron in the solution will indicate its presence. The calcination of the bread in an earthen crucible would require six or eight hours; in a platina capsule two or three hours are sufficient.

The precipitate occasioned by the ammonia, consists principally of phosphate of lime, phosphate of magnesia, oxide of iron, and a small quantity of alumine. The first filtration may be dispensed with when the detection of the copper is the sole object.

In these experiments, the entire freedom of the tests employed, from copper, is very important. Water, distilled from a copper alembic is rarely exempt from slight traces of the metal.

In a great number of trials which the author has made, the quantity of copper which he found was so small, that he was obliged to answer the question of any addition of sulphate to the materials of the bread, in the negative. From several facts it is inferred that traces of copper may naturally exist in flour, and consequently in the grain which produces it. This he considers to be true with respect both to wheat and rye. There is nothing in this fact surprising to chemists. M. *Sarzeaud* has detected this metal in several organic products, and M. Meissener, of Halle, has discovered it in a great number of plants. Still there is a wide difference between the quantity thus introduced by nature, and the smallest portion fraudulently added by the baker. Bread which contains $\frac{1}{70000}$ of sulphate, gives an ammoniacal liquor, which, when rendered slightly acid, becomes immediately rose colored by ferro-prussiate of potash, while that from wheat and flour requires a long time, and in many cases the prussiate of copper becomes apparent only from its giving a color to the white base, which appears to be a little earthy phosphate dissolved by the ammonia.

On the employment of alum in baking, and the means of detecting it in bread.

The use of alum appears to be very ancient. It serves to disguise the quality of bad flour, and even to enable the baker to add a portion of the flour of beans or peas, and perhaps of potatoes, without an easy detection.

The quantity of alum, requisite to make a light porous bread out of inferior flour, varies from $\frac{1}{127}$ to $\frac{1}{964}$ of the flour employed, or from $\frac{1}{145}$ to $\frac{1}{1077}$ of the bread obtained from it. It enables the baker also to dispense in whole or in part with the salts commonly used.

Its injurious action upon the health is not to be compared to that of sulphate of copper, and yet taken daily into the stomach, it may seriously affect the system.

Dr. Ure's method of detection is after soaking the washings of stale bread in distilled water, to press out the water, filter it, and test it by muriate of barytes. This, says our author, will shew $\frac{1}{686}$ of alum, but he does not deem it sufficiently exact to prove the existence of very small portions of alum, for he obtains a precipitate in that way, from bread without alum. The water with which the flower is mixed generally contains sulphate of lime, and as the barytic test only proves the existence of sulphuric acid, it does not determine the nature of the sulphate. The following is the author's method.

Incinerate 200 grains of bread, porphyrise the cinders, treat it with nitric acid, evaporate to dryness, dilute with about 20 grains of distilled water, add to the unfiltered mass pure caustic potash in excess, heat gently, filter, and add muriate of ammonia, until the alumina is all precipitated, which is best effected by boiling a few minutes. Collect the alumina on a filter, and determine by its weight the quantity of alum employed.

It may be observed, however, that the incinerated bread of wheat or rye will give sometimes a precipitate of alumina without any addition of alum, but in quantity so small, that its weight would occasion no sensible error in estimating the amount of the salt. It may be derived from earthy particles adherent to the grain, or from the hearth of the oven in which the bread is baked.

Bread which contains $\frac{1}{3420}$ of alum, gives an immediate precipitate of alumine, by this method.

So small a quantity produces no effect upon the quality of the bread, and cannot be regarded as of any importance to health.

The weight of the ashes of burnt bread will furnish the means of a pretty good estimate; 200 grains of pure white bread give 1.27 to 1.03 of ashes, while bread containing $\frac{1}{176}$ of alum, yield 1.6 of ashes. The latter is incinerated more easily, gives whiter ashes, and in much greater bulk.

Sulphate of Zinc has been, it appears, occasionally used in bread. As incineration might volatilize the zinc, the analysis must be managed in the humid way.

The presence of the acid may be detected by muriate of barytes, as in the case of alum. That of zinc as follows;—digest 200 grs. of the crumb in cold distilled water, press the fluid through a linen cloth, filter through paper, evaporate by gentle heat, till the liquid becomes somewhat viscid; add to it an excess of liquid ammonia, filter, acidulate slightly by nitric acid; divide the fluid into two portions, add to one prussiate of potash, to the other hydro-sulphate of ammonia. Both of these reagents will shew the presence of zinc, by a white precipitate, but the first most decisively. The precipitate ought to be soluble in an excess of ammonia.

Sub-Carbonate of Magnesia.

It has been stated by Edmund Davy, that from 20 to 40 grains of sub-carbonate of magnesia, intimately mixed with one pound of bad flour, will materially improve the quality of the bread. It is probable that the carbonate is converted by the fermentation into an acetate, and although the quantity of magnesia above mentioned may do no harm, it may not be amiss to show how it may be detected. Porphyrise the ashes of 200 grains, (or a larger quantity in any case if desirable,) dilute with acetic acid, and evaporate to dryness to expel any excess of acid. Treat the dry mass with alcohol and filter; evaporate again to dryness, and redissolve in a little water.

To this solution add a slight excess of bi-carbonate of potash and filter. By boiling this filtered liquid, the magnesia, if any exist, will separate in a white jelly. This process might be much simplified, if there did not exist in flour, phosphate of magnesia, the solution of which must be avoided.

Alkaline Sub-carbonates.

Many authors assert that sub-carbonate of ammonia contributes powerfully to promote the rising of bread, and to increase its whiteness. The volatility of this salt may possibly aid mechanically the extension of the dough, but since it is probable that the acetic acid developed by the fermentation would combine with the ammonia, it is doubtful whether much benefit would be derived from the use of this salt, unless employed in very large doses.

The existence of this or other alkalies can be detected by the methods which depend on their solubility, and other peculiar properties.

Other Substances.

Chalk, pipe clay and plaster have also been employed in the adulteration of bread. The design in these cases is to increase the weight of the bread and perhaps its whiteness. Their presence may be shewn, both by the increased weight which they give to the ashes, and by the tests usually employed to distinguish their component parts.

PART SECOND.

Series of experiments on bread making.

Considering the nature of the various materials resorted to for the purpose of disguising the quality of bad flour, it is difficult to conceive precisely in what manner they produce their effects.

The desire of proving experimentally the influence of sulphate of copper upon the progress of fermentation, induced the author to undertake a series of practical operations, upon the effects of this and various other salts. These results are given in the order in which they were obtained. The experiments were all made by the same baker in the author's presence.

First baking.

Several kinds of flour were tried.

1. Flour of 1829,—slack, (*lâchante*,)—giving a dough which spread out, without rising, so as to furnish only a heavy bread.

2. Flour called *pain d'avôt* from wheat called *blanzé*, ¼ of the bran only extracted.

3. Flour of brown bread; ten per cent. of bran extracted.

With each of these, equal portions of yeast and leaven were incorporated and made equally moist. Different quantities of sulphate of copper in solution were added, and mixed with the dough of different loaves, and kept in a warm place until fit for the oven.

It was observed that the loaves destitute of the sulphate, merely flattened out (pousser plat,) without increasing in height, while those which contained the smallest quantity swelled more and more, and broke upon the surface, and the greater number became very porous. Those however which had received the greatest proportion of copper, did not sensibly increase in volume, and remained flat. They were all baked together, remaining in the oven about half an hour. The results are exhibited in the table.

Observations on the first baking.

Bakers are generally of opinion, that there are two distinct actions in the rising of bread, the one owing to the leaven, which consists in strengthening the paste, the other to the yeast and leaven together, in the development of gas and increase of volume.

The presence of sulphate of copper in all the trials is very manifest, even when used in the smallest quantity, in strengthening the paste and preventing its spreading into a flat mass.

An excess of this poisonous salt however, is essentially injurious to the rising of the bread. It impedes the fermentation. Its action appears very analogous to that of leaven. An excess of either gives rise to the same odor.

Besides the property of furnishing a finer, more porous and lighter bread, when the proportion does not exceed the $\frac{1}{10000}$ of the quantity of bread, the sulphate of copper enables it to retain a greater quantity of water, so that the loaf No 7, lost almost nothing of its weight.

To prove more distinctly whether the increase in weight was in proportion to the metallic sulphate employed, recourse was had to a second baking, the result of which was, that 1125 parts of flour, 625 parts of water, 260 parts of leaven, 90 parts of yeast, produce a loaf, which, twenty four hours after it is withdrawn from the oven, weighs 1720 parts, the height being 6½ centimeters, and the width 30. The same quantity of ingredients, precisely in the same proportions, with the addition of .025 of sulphate of copper, the weight was 1745, the height 8½, and the width 30. With .05 of sulphate of copper, the weight was increased to 1762, the height to 9, the width 29½. Each of these additions of the sulphate, greatly improved the appearance, lightness and sponginess of the bread. The quantity of sulphate in proportion to the bread was in these two cases $\frac{1}{69800}$ and $\frac{1}{33240}$. A larger quantity of sulphate increased the weight of the bread but injured its appearance and quality.

Observations on the second baking.

The results were 1. The action of the copper on the quality of the bread is very manifest and very favorable, even in the proportion of $\frac{1}{69800}$.

2. The increase of weight is very sensible, amounting even to an ounce in a pound, when $\frac{1}{9060}$ of sulphate was used. When the same quantity of water was added to an equal quantity of paste exempt from the cupreous salt, it gave a loaf very spreading, very heavy, exactly half the height, and weighing 8 per cent. less than the preceding.

3. The suppression of leaven in counteracting an excess of copper was very decided, for the bread containing $\frac{1}{1800}$ in the former batch, which remained to be a mere paste, gave in the latter a very fine, porous, and well raised bread, simply by omitting the leaven; but the salt manifested itself by a disagreeable odor and a verdigrease taste.

Conclusions relative to the action of various agents, as determined by experiments.

Sulphate of copper.—This salt exerts an extremely energetic action on the fermentation and rising of bread, even when employed in the proportion of $\frac{1}{70000}$, which is about one part of metallic copper to 300,000 of bread, or 1 grain of sulphate in 7½ lbs. of bread. The proportion which produces the best rising is from $\frac{1}{30000}$ to $\frac{1}{15000}$; beyond this it becomes too moist, less white, and acquires an odor like leaven.

It is easy to obtain by the use of this salt, well raised bread from flour called slack, (lâchantes,) or moist. It may occasion the retention of water to the amount of an ounce in a pound without injury to the bread. In the summer season there is the greatest need of strengthening the paste and preventing the spreading of the loaf. It is usually done by leaven and common salt, but a very small quantity of sulphate of copper, will serve as a substitute for both, only it is necessary to increase a little the quantity of yeast.

The greatest quantity of this salt which can be introduced without altering the beauty of the bread is $\frac{1}{4000}$. With $\frac{1}{1800}$ the paste will not rise, all fermentation is stopped, and the bread acquires a green color. By omitting the leaven, and introducing more water, it rises well, and becomes very porous, but it is moist, greenish and disagreeable.

It is evidently the base of the salt, much more than the acid, that produces these effects on panification, for sulphate of soda, sulphate of iron, and even sulphuric acid, have not, in comparative trials, furnished analogous results.

Alum.—The effects of this salt are much the same as those of sulphate of copper, but it must be used in much larger quantity. The latter in the proportion of $\frac{1}{3500}$ is so great as to diminish the rising, but that quantity of alum produces no apparent result. It must be increased to $\frac{1}{686}$ to produce any sensible effect. In the dose of $\frac{1}{176}$

the effect is more remarkable. The action of alum (except as it regards quantity) is much the same as that of sulphate of copper. In the baker's phrase, it makes the bread *swell large.*

Sulphate of Zinc.—The results obtained from this salt are inconsiderable, and the author is persuaded that if any supposed efficacy has been attributed to it, it must have been confounded with sulphate of copper.

Sub-carbonate of Magnesia.—No great effect on the rising of bread. In the proportion of $\frac{1}{442}$ it produces a yellowish color, which may relieve the dark color of spoiled flour.

Sub-carbonate of ammonia.—No very remarkable result. By being changed to acetate it may perhaps, in common with the carbonates of potash and soda, preserve the moisture of bread for a longer period.

Marine salt.—Like alum and sulphate of copper, it strengthens the paste, but with less power. It does not produce a bread so white nor so well divided a crumb, as the other salts. Bread, however, is much better for the use of it, for alum and copper give very little taste. Their crumb is more like that of a light cake than of common bread.

A sufficient quantity of common salt may, like alum and copper, serve as a substitute for leaven.

Summary.—An experimental inquiry into the remarkable effects of sulphate of copper in the process of panification, elicits the encouraging fact that the presence of this venomous substance can, in the very smallest proportion, be detected by chemical analysis.

Every consumer may apply the means of determining its existence in bread, when in quantity too small to occasion any serious inconvenience. A drop of *prussiate of potash* let fall on the bread, in a few seconds, gives a rose color, even when the sulphate is only $\frac{1}{9000}$ part of the mass.

These researches also prove that the sulphate of copper cannot be introduced into bread, in very large quantity, not even in the proportion of $\frac{1}{3500}$ part, without injuring its appearance, and arresting the fermentation of the dough. A disagreeable odor also becomes manifest as soon as the proportion of the sulphate exceeds $\frac{1}{7000}$ part of the bread.

The author expresses the hope that the numerous experiments, detailed in his memoir, will throw some additional light on the subject of panary fermentation—still too obscure to justify any attempt at an explanation of the manner in which that process is affected by the various substances, which have been the subject of his trials. The art of bread making, one of the most ancient and the most useful, is probably as little understood, in theory, as almost any other. A perfect acquaintance with the theory of panification would probably be of great utility, especially in the use of flour of an inferior quality, or of damaged flour. The least discovery in the rationale of this process may become of great importance. Of what great utility has been the application of yeast, or how important in the fabrication of bread has been the employment of the fecula of the potatoe!

Whole volumes have been devoted to the culture of the cerealia, and seldom do we meet with a page on the making of bread, the final object of such cultivation.

While chemists have entered zealously into the process of sugar refining, extraction of gelatine from bones, the improvement of wine making, distillation, &c. bread, by far the most important article of our food, has scarcely engaged their serious attention. A few machines for kneading dough, and those of recent invention, are nearly all that we find in the way of improvement.

It is this continued ignorance with respect to the chemistry of the art, which causes bakers to lay so great a stress upon every secret process. The remarkable effects of sulphate of copper and alum, greatly encourage their avidity. To obtain a whiter, more porous, and finer grained bread, and in greater quantity from a given weight of flour, and at the same time to dispense with the preparation of leaven, are advantages too great to prevent the apprehension that they will be greatly abused, and the public health grossly neglected. The proper authorities ought not to be inactive in a matter of so much importance.

TABLE.

No.	Relative quantity of Bread and foreign materials.	Mean dimensions of the loaves in centimeters. Height.	Width.	*Observations.*
1	Without foreign substance.	$6\frac{1}{2}$	28	Loaf fine, though rather compact,—small eyes,—well baked, uniform grain, very white, sweet or mild flavor. Result rather inferior to what is commonly obtained.
2	$\frac{1}{29000}$ of sulphate of copper.	$8\frac{1}{2}$	26	Very handsome, fine grain, round and elevated form, of a more beautiful white than the preceding, on account of its greater porosity.
3	$\frac{1}{15300}$ idem.	$10\frac{1}{4}$	26	As handsome as the preceding,—raised throughout its whole width and consequently more voluminous. It was as fine a loaf as possible, but rather tasteless. It would be very difficult, the baker stated, to obtain with this flour, by the common methods, a loaf so light and elastic as those of Nos. 2 and 3; for if by increasing the quantity of yeast, we endeavor to swell it out, the bread will not be so light, and will be liable to acquire a bitter taste. It will at first rise and then sink in the oven. If this result had been foreseen, the baker added, it might have been allowed to expand still more by putting more water in the dough and kneading it more; the bread would have been as fine and larger.
4	$\frac{1}{8700}$ idem.	$9\frac{1}{2}$	$26\frac{1}{2}$	Very fine bread, well raised in all its dimensions, color rather more gray than the preceding, its odor somewhat like brown bread.

No.	Relative quantity of Bread and foreign materials.	Mean dimensions of the loaves in centimeters.		*Observations.*
		Height.	Width.	
5	$\frac{1}{7360}$ idem.	$9\frac{1}{2}$	28	Loaf swelled to the largest size.—Very large eyes, color more grey than No. 4. Dough sour smell, somewhat greasy. A similar odor, the baker states, is developed when too much leaven is put into the dough.
6	$\frac{1}{3590}$ idem.	$8\frac{1}{2}$	$28\frac{1}{2}$	Rather less raised than No. 4. Very large eyes, color sombre, with a tinge of green, smell like No. 5, but stronger. Very greasy and heavy.
7	$\frac{1}{1875}$ idem.	6	25	A real dough, penetrated with several large holes, with blisters on its surface; a humid aspect, green color, smell like sour starch, a doughy taste, with a metallic after taste. The baker pretends that simple dough without leaven or yeast, would have risen as much.
				Household bread, (pain d'avôt ou de ménege.)
8	unmixed.	$5\frac{1}{2}$	27	Ordinary whiteness, but not so light as common, tougher, well baked.
9	$\frac{1}{36700}$ sul. of copper.	8	28	Incomparably finer than the foregoing, well risen, high in every part, more porous than No 8, color similar, odor much the same.
10	$\frac{1}{20600}$ idem.	9	29	At least as fine as No. 9. The baker says it would be very difficult to obtain, even with the greatest labor, bread of this kind, of so good a quality, without sulphate of copper. This is the more remarkable as it is the result of a trial on a small scale, and of course under unfavorable circumstances.

No.	Relative quantity of Bread and foreign materials.	Mean dimensions of the loaves in centimeters — Height.	Width.	Observations.
11	$\frac{1}{9850}$	$8\frac{1}{2}$	29	Larger eyes than the preceding, more moist, dough of sour smell, color dull.
12	$\frac{1}{7520}$	$8\frac{1}{2}$	27	Eyes irregular, hollow within, moist, brown color, smell strong.
13	$\frac{1}{3560}$	$7\frac{1}{2}$	26	Compact and heavy, very moist, brown, greenish, smell sour. Its bad quality is owing to excess of copper. Longer baking might have helped it.
14	$\frac{1}{1390}$	8	24	More pasty than the last, hollow, crust separates from the crumbs, green, very disagreeable odor, pretty free from excess of copper.
				Brown bread.
15	unmixed.	6	26	Fine, rather flat, uniform grain, the smell of bran not disagreeable.
16	$\frac{1}{7400}$ sul. of cop.	7	$27\frac{1}{2}$	Much lighter than the last, more moist and friable, deeper color, and doughy smell.
17	$\frac{1}{3720}$ idem.	$7\frac{1}{2}$	25	Doughy, very greasy, sticking to the knife, numerous large fissures, color very dull, smell of leaven, strong and disagreeable. Much injured by excess of copper.

Art. VIII.—*Chemical Examination of the Bark of the White Birch; by* Owen Mason, of Providence, R. I.

When residing in the country some years since, I had frequent opportunities of observing the extreme combustibility of the exterior bark, or cuticle, of the white birch, (Betula alba,) and its durability, when exposed in situations favorable for a speedy decomposition. In every swamp where the white birch abounds, there are usually many trees which have been prostrated by the winds, and those will generally be found in a state of decay while the bark, which covers them, is entirely sound. The bark may easily be collected in cylindrical pieces, by shaking out its rotten contents. These cylinders are frequently converted into baskets and other articles, and very often employed for kindling materials, and for torches, in the nocturnal excursions of youthful anglers. Recollecting these facts, I was induced to undertake a few experiments, with a view of ascertaining to what principle the bark owes its inflammability, and its power to resist the ordinary agents of decay.

A portion of the bark, chipped fine, was acted upon by boiling water. The water separated neither volatile oil nor wax. It contained some extractive matter and tannin. Upon the same portion of bark, highly rectified alcohol was kept in gentle ebullition a long time. The alcohol was decanted off and suffered to cool, and a very copious curdly precipitate formed. When the whole of the alcohol was evaporated, a granular substance was obtained, which resembled, in appearance, the lighter varieties of muscovado sugar, or more closely, the sugar from starch. This substance possessed the following properties: It was extremely combustible, and when thrown upon hot coals, it diffused throughout the apartment, a peculiar and very agreeable odor. It fused at a temperature of 454°.* After fusion, it resembled the darker varieties of the resin from pine. By friction it exhibited negative electricity. It was insoluble in water, but it readily dissolved in alcohol and ether. With several of the essential oils it combined, but with much greater difficulty than common resin. With the oil of turpentine, however, it very readily formed a clear solution. It combined with solution of potassa, and from this alkaline solvent it was separated by the addition of an acid.

These characters entitle this substance to a rank among the resins, and at the same time, they are sufficiently distinctive of a peculiar variety. The high temperature at which it fuses, and the odor afforded when thrown upon hot coals, are characteristic of no similar body. The bark, when acted upon by repeated portions of boiling alcohol, becomes no more combustible than ordinary woody fibre, and as all

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* A small quantity of the birch resin was put into a glass tube, and a like quantity of common resin in another. The tubes, together with a thermometer, were placed in oil, which was heated over a furnace. The temperatures at which the resins began to melt was noted. Common resin, under these circumstances, melted at 218° Faren.

vegetable bodies, containing a large proportion of resin, are known to resist decomposition for ages, the combustibility of the bark and its enduring qualities when exposed to heat and moisture, are unquestionably due to its resinous ingredient.

The resin constitutes a great proportion of the bark; so great a proportion indeed, that when heated in close vessels, the whole mass appears to melt. It is singular that the resin, when so abundant, never manifests itself by a spontaneous exudation from the tree.

In the course of some of the experiments detailed above, I spread a portion of the resin upon a paper, and placed it upon a warm stove, with a view to dry it effectually. In this situation it was accidentally subjected to so high a temperature, that a portion of the resin began to melt. Attracted by the odor with which the room was filled, I immediately removed it from the stove, and was surprised to find that the whole surface of the resin was covered with brilliant acicular crystals, radiating from every elevated point, and crossing each other at every possible angle. This crystalline matter resembled benzoic acid so closely that at first I supposed it was that substance, and consequently, the resin containing it belonged to the class of *balsams*. A subsequent examination, however, convinced me that that supposition was erroneous although it was not decisive of the real nature of the substance.

It is extremely difficult to obtain this body in large quantities, and no means that I have applied, have proved more effectual than those by which it was first procured. It possessed the following properties:

It experienced no change by exposure to the atmosphere for weeks. It was destitute of taste, and, at common temperatures, of smell. When gently heated, it afforded the peculiar odor of the resin.

The copious vapors, arising from it, could be inhaled without any of that irritation of the respiratory organs which the vapor of benzoic acid occasions. It was absolutely insoluble in cold water, and very sparingly so, if at all, in hot. It combined instantly with alcohol and ether. Digested with dilute muriatic and nitric acids, imperfectly crystallized compounds were formed, which possessed a strong bitter taste.

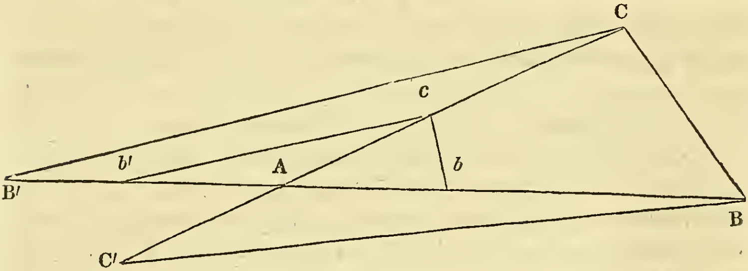
If this examination be too imperfect to authorise any decision upon the chemical nature of this substance, it is, I think, nevertheless conclusive as to those properties which distinguish it from the benzoic acid, which it so much resembles in appearance.

Should this body prove to be a *new* proximate principle, the name *betuline*, suggested by a distinguished scientific gentleman, who has seen some of it, would be particularly appropriate.

I have obtained considerable quantities of resin from the thin cuticle of the black birch, (Betula nigra). In its general properties it resembles that obtained from the white birch. It is, however, of a darker color, and gives off, when burning, a slightly empyreumatic odor. I have been unable to detect any of the crystalline matter in it.

Art. IX.—*On Analytical Geometry;* by C. Wilder.

Let A, B, and C, be points in any surface whatever, connected by the lines AB, AC, and BC or x, y, and z, the shortest that can be drawn on that surface between those points.



Then $x+y>z$, $y+z>x$, or $z>x-y$ (x being greater than y,) or what is the same thing $z<x+y$ and $>\sqrt{(x+y)^2-4xy}$,

$$z<\sqrt{(x-y)^2+4xy} \text{ and } >x-y,$$

and which shews by inspection alone, that when A and B are comprised between 0 and 1, that we may write $z=\sqrt{(x+y)^2-4Axy}$,

$$z=\sqrt{(x-y)^2+4Bxy},$$

from these equations, we find

$$4A=\frac{-z^2+(x+y)^2}{xy}=\frac{-z}{x}\cdot\frac{z}{y}+\frac{x}{y}+\frac{y}{x}+2,$$

$$4B=\frac{z^2-(x-y)^2}{xy}=\frac{z}{x}\cdot\frac{z}{y}-\left(\frac{x}{y}+\frac{y}{x}-2\right)$$

When therefore the angles of the triangle ABC depend on the relative position of the points A, B and C, A and B will be functions of those angles, and consequently independent of x, y and z. Let us make $x=y=Ac=1$, then

$$A^{\frac{1}{2}}=\frac{\sqrt{4-z^2}}{2},$$

$$B^{\frac{1}{2}}=\frac{z}{2}=\frac{bc}{2},$$

It thus appears that A and B may be treated as functions solely of the angle BAC. Accenting, to designate the other angles, and we have

$$\left.\begin{array}{l} z^2=x^2+y^2+2(1-2A)xy \\ z^2=x^2+y^2-2(1-2B)xy \end{array}\right\} \quad (1)$$

$$\left.\begin{array}{l} y^2=x^2+z^2+2(1-2A')xz \\ y^2=x^2+z^2-2(1-2B')xz \end{array}\right\} \quad (2)$$

$$\left.\begin{array}{l} x^2=y^2+z^2+2(1-2A'')yz \\ x^2=y^2+z^2-2(1-2B'')yz \end{array}\right\} \quad (3)$$

From the identity of the second members of (1), (2) and (3), result

$$A+B=1$$
$$A'+B'=1$$
$$A''+B''=1$$

Adding the corresponding equations of (1) and (2), and dividing by $2x$, of (1) and (3) and dividing by $2y$, and of (2) and (3) dividing by $2z$, we get

$$x+(1-2A)y+(1-2A')z=0 \qquad (4)$$
$$(1-2A)x+y+(1-2A'')z=0 \qquad (5)$$
$$(1-2A')x+(1-2A'')y+z=0 \qquad (6)$$

From these three equations, we easily derive the equation of condition $(1-2A)^2+(1-2A')^2+(1-2A'')^2+1-2(1-2A)(1-2A')(1-2A'')=0$, between the angles of the triangle ABC.

Resuming the values of A and B, (observing that the difference of the squares of two numbers is equal to the product of their sum and difference) and

$$16AB=\frac{2x^2y^2+2x^2z^2+2y^2z^2-(x^4+y^4+z^4)}{x^2y^2}=$$
$$\frac{(x+y+z)}{x}\,\frac{(x+y-z)}{y}\,\frac{(x-y+z)}{x}\,\frac{(-x+y+z)}{y}$$

in the same manner

$$16A'B'=\frac{2x^2y^2+2x^2z^2+2y^2z^2-(x^4+y^4+z^4)}{x^2z^2}.$$

$$16A''B''=\frac{2x^2y^2+2x^2z^2+2y^2z^2-(x^4+y^4+z^4)}{y^2z^2}$$

and consequently, $\frac{AB}{A'B'}=\frac{z^2}{y^2}$, $\frac{AB}{A''B''}=\frac{z^2}{x^2}$ and $\frac{A'B'}{A''B''}=\frac{y^2}{x^2}$ (7).

When the angles of the triangle ABC depend on the relative position of the points A, B, and C, it is manifest that AB, AC, and BC, are determined in position by the position of any two points through which they pass; let therefore AB′ or x' be the continuation of AB, and then we have in the triangle BB′C

$$B'C^2 = z'^2 = (x'+x)^2 + z^2 + 2z(x'+x)(1-2A')$$

writing for z^2, its value, $x^2+y^2+2(1-2A)xy$, and for $(1-2A')$ its value, $-\frac{x+(1-2A)y}{z}$, drawn from (4) and

$$z'^2 = x'^2 + y^2 - 2(1-2A)x'y.$$

We thus see that in passing from the triangle ABC to AB′C it is sufficient to change the sign of either x, or $1-2A$.

In the same manner, it is shown, that to pass from the triangle ABC to ABC′ along AC, the sign of y, or $1-2A$, must be changed. Let us make in $x'^2+y^2-2(1-2A)x'y=z'^2$

$x'=y=Ac=1$ and then $\quad A^{\frac{1}{2}} = \frac{z'}{2} = \frac{b'c}{2}.$

The magnitude and position of x, y, and z, being determined by the position of their extremities, the surface S, comprised by those lines must also depend on the same conditions. We ought therefore to have $S=F(xy\varphi)=F'(xz\varphi')$, φ and φ' designating the angles BAC, ABC, but from the equations (7) $x^2y^2AB=x^2z^2A'B'$; from which it follows that $(x^2y^2AB)^n$ is the general term of F; put therefore $S=C(x^2y^2AB)^a+p$ and then we shall have for the triangle AB′C, $S'=C(x'^2y^2AB)^a+p'$ and for the triangle BCB′, $S''=C((x'+x)^2z^2A'B')^a+p''$; but $S''=S+S'$ and $z^2A'B'=y^2AB$; we have then

$$C\times((x'+x)^2y^2AB)^a+p''=C\times(y^2AB)^a(x'^{2a}+x^{2a})+p+p'$$

and consequently, (since this equation is identical,) when $x=x'$, $(2x)^{2a}=2x^{2a}$ or $2^{2a}=2$ we have then $a=\frac{1}{2}$. In the same manner may it be shown, that in the second, third, etc. terms of the development of F, $\beta=\frac{1}{2}$, $\gamma=\frac{1}{2}$, etc. and consequently we have, $S=pxy\sqrt{AB}$, p being a quantity depending on the nature of the surface. Writing for AB, its value, and

$$S=\frac{p}{4}\sqrt{(x+y+z)(x+y-z)(x-y+z)(-x+y+z)}.$$

The resolution of the first member of $A+B=1$ into two factors of the same degree gives

$$\left.\begin{aligned} A^{\frac{1}{2}}+B^{\frac{1}{2}}\sqrt{-1}&=a^{\pm n}\\ A^{\frac{1}{2}}-B^{\frac{1}{2}}\sqrt{-1}&=a^{\mp n}\end{aligned}\right\}\quad(8)$$

$$\left.\begin{aligned} A^{\frac{1}{2}}\sqrt{-1}+B^{\frac{1}{2}}&=a^{\pm n'} \\ -A^{\frac{1}{2}}\sqrt{-1}+B^{\frac{1}{2}}&=a^{\mp n'} \end{aligned}\right\} (9)$$

and consequently $$\left.\begin{aligned} A^{\frac{1}{2}}&=\frac{a^{\pm n}+a^{\mp n}}{2} \\ B^{\frac{1}{2}}&=\frac{a^{\pm n}-a^{\mp n}}{2\sqrt{-1}} \end{aligned}\right\}$$

$$A^{\frac{1}{2}}=\frac{a^{\pm n'}-a^{\mp n'}}{2\sqrt{-1}}$$

$$B^{\frac{1}{2}}=\frac{a^{\pm n'}+a^{\mp n'}}{2}$$

Comparing the 1st equation of (8) multiplied by $-\sqrt{-1}$, and the 2d by $\sqrt{-1}$, with the second and first of (9) and $a^{\mp n'}=\mp a^{\pm n}\sqrt{-1}$.

Elevating (8) and (9) to the power m, and abridging the first members and their results,

$$C^{\frac{1}{2}}+D^{\frac{1}{2}}\sqrt{-1}=a^{\pm mn},$$

$$C^{\frac{1}{2}}-D^{\frac{1}{2}}\sqrt{-1}=a^{\mp mn},$$

$$C^{\frac{1}{2}}\sqrt{-1}+D^{\frac{1}{2}}=a^{\pm mn'},$$

$$-C^{\frac{1}{2}}\sqrt{-1}+D^{\frac{1}{2}}=a^{\mp mn'},$$

$$C^{\frac{1}{2}}=\frac{a^{\pm mn}+a^{\mp mn}}{2},$$

$$D^{\frac{1}{2}}=\frac{a^{\pm mn}-a^{\mp mn}}{2\sqrt{-1}},$$

$$C^{\frac{1}{2}}=\frac{a^{\pm mn'}-a^{\mp mn'}}{2\sqrt{-1}},$$

$$D^{\frac{1}{2}}=\frac{a^{\pm mn'}+a^{\mp mn'}}{2}.$$

It is thus seen that $C^{\frac{1}{2}}$, and $D^{\frac{1}{2}}$, are the same functions of mn, or mn', that $A^{\frac{1}{2}}$ and $B^{\frac{1}{2}}$ are of n, or n', and consequently if $\frac{A^{\frac{1}{2}}}{2}$ or $\frac{B^{\frac{1}{2}}}{2}$ subtends the angle BAC or n, $\frac{C^{\frac{1}{2}}}{2}$ or $\frac{D^{\frac{1}{2}}}{2}$, will, when not greater than unity, subtend the angle mn.

From (8) we have $\frac{A^{\frac{1}{2}}+B^{\frac{1}{2}}\sqrt{-1}}{A^{\frac{1}{2}}-B^{\frac{1}{2}}\sqrt{-1}}=a^{\pm 2n}$. Or developing,

$$n=\frac{\sqrt{-1}}{1.\, a}\left(\left(\frac{B}{A}\right)^{\frac{1}{2}}-\frac{1}{3}\left(\frac{B}{A}\right)^{\frac{3}{2}}+\frac{1}{5}\left(\frac{B}{A}\right)^{\frac{5}{2}}-\text{ etc.}\right)$$

Or putting φ for the real factor of the second member, and $n=\varphi\sqrt{-1}$, (φ designating the angle BAC,) it appears, from the equation $a^{\pm n'}=\mp a^{\mp n}\sqrt{-1}$, (if χ designate the angle B′AC) that $a^{\pm(\varphi+\chi)\sqrt{-1}}=\sqrt{-1}$: the sum of these angles is thus seen to be constant and to have opposite signs. Put φ', and φ'', to represent the angles ABC, BAC, and equations (1), (2) and (3), become

$$x^2+y^2-xy(a^{\pm 2\varphi\sqrt{-1}}+a^{\mp 2\varphi\sqrt{-1}})=z^2, \qquad (1)'$$

$$x^2+z^2-xz(a^{\pm 2\varphi'\sqrt{-1}}+a^{\mp 2\varphi'\sqrt{-1}})=y^2, \qquad (2)'$$

$$y^2+z^2-yz(a^{\pm 2\varphi''\sqrt{-1}}+a^{\mp 2\varphi''\sqrt{-1}})=x^2. \qquad (3)'$$

and (4), (5) and (6) become

$$2x-(a^{\pm 2\varphi\sqrt{-1}}+a^{\mp 2\varphi\sqrt{-1}})y-(a^{\pm 2\varphi'\sqrt{-1}}+a^{\mp 2\varphi'\sqrt{-1}})z=0, (4)'$$

$$-(a^{\pm 2\varphi\sqrt{-1}}+a^{\mp 2\varphi\sqrt{-1}})x+2y-(a^{\pm 2\varphi''\sqrt{-1}}+a^{\mp 2\varphi''\sqrt{-1}})z=0, (5)'$$

$$-(a^{\pm 2\varphi'\sqrt{-1}}+a^{\mp 2\varphi'\sqrt{-1}})x-(a^{\pm 2\varphi''\sqrt{-1}}+a^{\mp 2\varphi''\sqrt{-1}})y+2z=0, (6)'$$

and since $A^{\frac{1}{2}}B^{\frac{1}{2}}=\frac{a^{\pm 2\varphi\sqrt{-1}}-a^{\pm 2\varphi\sqrt{-1}}}{4\sqrt{-1}}$, (7) is changed to

$$\frac{z}{y}=\frac{a^{\pm 2\varphi\sqrt{-1}}-a^{\mp 2\varphi\sqrt{-1}}}{a^{\pm 2\varphi'\sqrt{-1}}-a^{\mp 2\varphi'\sqrt{-1}}},\quad \frac{z}{x}=\frac{a^{\pm 2\varphi\sqrt{-1}}-a^{\mp 2\varphi\sqrt{-1}}}{a^{\pm 2\varphi''\sqrt{-1}}-a^{\mp 2\varphi''\sqrt{-1}}} \qquad (7)'$$

Resolving the first members of (1)′ into two factors of the first degree and we have the following equations.

$$\left.\begin{aligned} x-ya^{\pm 2\varphi\sqrt{-1}}&=za^{\pm n}\\ x-ya^{\mp 2\varphi\sqrt{-1}}&=za^{\mp n}\end{aligned}\right\} \qquad (12)$$

$$\left.\begin{aligned} -xa^{\pm 2\varphi\sqrt{-1}}+y&=za^{\pm n'}\\ -xa^{\mp 2\varphi\sqrt{-1}}+y&=za^{\mp n'}\end{aligned}\right\} \qquad (13)$$

Taking the difference of the two equations of (12) and

$$\frac{z}{y}=\frac{a^{\pm 2\varphi\sqrt{-1}}-a^{\mp 2\varphi\sqrt{-1}}}{a^{+2\varphi'\sqrt{-1}}-a^{\mp 2\varphi'\sqrt{-1}}}=\frac{a^{\pm 2\varphi\sqrt{-1}}-a^{\mp 2\varphi\sqrt{-1}}}{-a^{\pm n}+a^{\mp n}},$$ and consequently $n=-2\varphi'\sqrt{-1}$. In the same manner by taking the difference of the two equations of (13) $n'=-2\varphi''\sqrt{-1}$; we have therefore for (12) and (13)

$$\left.\begin{array}{l} x-ya^{\pm 2\varphi\sqrt{-1}}=za^{\mp 2\varphi'\sqrt{-1}} \\ x-ya^{\mp 2\varphi\sqrt{-1}}=za^{\pm 2\varphi'\sqrt{-1}} \end{array}\right\} \quad (12)'$$

$$\left.\begin{array}{l} -xa^{\pm 2\varphi\sqrt{-1}}+y=za^{\mp 2\varphi''\sqrt{-1}} \\ -xa^{\mp 2\varphi\sqrt{-1}}+y=za^{\pm 2\varphi''\sqrt{-1}} \end{array}\right\} \quad (13)'$$

Multiplying the first equation of (12)′ by $-a^{\mp 2\varphi\sqrt{-1}}$, and comparing with the second of (13)′, and $a^{\mp 2(\varphi+\varphi')\sqrt{-1}}=-a^{\pm 2\varphi''\sqrt{-1}}$ or better $a^{\mp(\varphi+\varphi'+\varphi'')\sqrt{-1}}=\sqrt{-1}$. We see from this equation, that the three angles of the triangle ABC, are equal to the two BAC+B′AC, and consequently that B′AC$=\varphi'+\varphi''=$ABC+ACB.

In a series of triangles whose sides are x, y and z, x, y and z', etc. and included angles φ, 2φ, 3φ, etc.; we have

$$x-ya^{\pm 2\varphi\sqrt{-1}}=za^{\mp 2\varphi'\sqrt{-1}}$$

$$x-ya^{\pm 4\varphi\sqrt{-1}}=z'a^{\mp 2\varphi''\sqrt{-1}}$$

$$x-ya^{\pm 6\varphi\sqrt{-1}}=z''a^{\mp 2\varphi'''\sqrt{-1}}, \text{ etc.}$$

and consequently when $a^{\pm\varphi\sqrt{-1}}$ is a root of the equation $r^n\pm 1=0$, different from unity, the first members are factors of $x^n\pm y^n$; we have, therefore, $x^n\pm y^n=zz'z''a^{\mp 2(\varphi'+\varphi''+\varphi''')\sqrt{-1}}$, etc.; the theorem of Cotes, when the triangles have one side x common.

Cincinnati, April 15, 1831.

ART. X.—*On Central Forces;* by Prof. THEODORE STRONG.

(Continued from p. 73 of this Volume.)

PUT $F\varphi=1-e\cos.\varphi$, then $Fnt=1-e\cos.nt$, $F'nt=e\sin.nt$; hence by (0) $1-e\cos.\varphi=1-e\cos.nt+e^2\sin.^2nt+\frac{e^3}{1.2}\frac{d\sin.^3nt}{ndt}+\frac{e^4}{1.2.3}\frac{d^2\sin.^4nt}{n^2dt^2}+$etc. but by (5) $1-e\cos.\varphi=\frac{r}{a}$, hence by substituting this value, and the values of $\sin.^2nt$, $\sin.^3nt$, &c. (see La Croix's Traité de Calcul Différentiel, etc. p. 314,) then taking the differentials (as indicated by the formula, making ndt constant,) and there results the equation $\frac{r}{a}=1+\frac{e^2}{2}-e\cos.nt-\frac{e^2}{2}\cos.2nt-\frac{e^3}{1.2.2^2}(3\cos.3nt-3\cos.nt)-\frac{e^4}{1.2.3.2^3}(4^2\cos.4nt.-4.2^2\cos.2nt)-$etc. (1), (see Mec. Cel. Vol. I, p. 179.) It may be well to observe, that (s) gives the solution of Kepler's Problem, supposing v to be calculated to terms, including e^6 only; but it is easy to see that the value of v can be easily calculated by the method which I have given to terms involving any integral positive powers of e which may be desired. If $e>1$, the conic section is an hyperbola, $a=$ its semitransverse axis, $e=$ its focal distance $\div a$, as in the case of the ellipse. In this curve $p'=a(e^2-1)$, $r=\frac{a(e^2-1)}{1+e\cos.v}$ (2), $c'dt=r^2dv=\frac{p'^2dv}{(1+e\cos.v)^2}$; put $\frac{c'^2}{p'}=g$, $\sqrt{\frac{g}{a^3}}=n$, then $ndt=\frac{(e^2-1)^{\frac{3}{2}}dv}{(1+e\cos.v)^2}$ (3). By (2) $dr=\frac{ae(e^2-1)\sin.vdv}{(1+e\cos.v)^2}$ and $\sin.v=\frac{a\sqrt{e^2-1}\times\sqrt{\left(\frac{a+r}{a}\right)^2-e^2}}{er}$; hence (3) becomes $ndt=\frac{rdr}{a^2\sqrt{\left(\frac{a+r}{a}\right)^2-e^2}}$, put $\frac{a+r}{a}=\frac{e}{\cos.\varphi}$, or $r=a\left(\frac{e}{\cos.\varphi}-1\right)$ (4), then $ndt=ed\tan.\varphi-\frac{d\varphi}{\cos.\varphi}$, or by integration $nt=e\tan.\varphi-h.l.\tan.\left(\frac{\varphi}{2}+\frac{P}{4}\right)$ (5), v, φ, and t being reckoned from the perihelion, and $P=$ the semicircumference of a circle rad.

$=1$. By comparing (2) and (4) I have $\frac{e^2-1}{1+e\cos. v}=\frac{e}{\cos.\varphi}-1$, hence $\tan.\frac{v}{2}=\sqrt{\frac{e+1}{e-1}}\times\tan.\frac{\varphi}{2}$ (6); (see Mec. Cel. p. 187, Vol. I.)

I will now suppose that the parameters of the conic sections are indefinitely diminished, so that they may be considered as differing insensibly from right lines. Let $a=$ half the transverse axis of the section, (if it is an ellipse, or hyperbola,) which is supposed to be invariable, when the parameter is diminished; $r=$ the distance of the particle from the centre of force at any time t, $V=$ the velocity of the particle, $V'=$ the velocity of a particle of matter describing a circle around the centre of force at the distance r, $F=\frac{A}{r^2}=$ the central force, ($A=$ const.) Then by (10) and (11) given at pp. 331, 332, Vol. XVII. $V=V'\sqrt{\frac{2a-r}{a}}$ (7), when the section is an ellipse; $V=V'\sqrt{\frac{2a+r}{a}}$ (8) when it is an hyperbola; and $V=V'\sqrt{2}$ (9), when it is a parabola. Now $\frac{V'^2}{r}=F=\frac{A}{r^2}$, or $V'=\sqrt{\frac{A}{r}}$, let $V''=$ the velocity of a particle describing a circle about the centre of force at the distance a, in the ellipse or hyperbola, and at any assumed distance, p, in the parabola; then $\frac{V''^2}{a}=\frac{A}{a^2}$, or $A=aV''^2$, when the section is an ellipse, or hyperbola, and $A=pV''^2$, when it is a parabola; hence by substitution $V'=V''\sqrt{\frac{a}{r}}$ in the ellipse, or hyperbola, and $V'=V''\sqrt{\frac{p}{r}}$ in the parabola; by substituting these values of V' in (7), (8), (9), they become $V=V''\sqrt{\frac{2a-r}{r}}$ (10), $V=V''\sqrt{\frac{2a+r}{r}}$ (11), $V=V''\sqrt{\frac{2p}{r}}$ (12,) respectively. Now when the parameters of the sections are indefinitely diminished, it is evident that the focus in which the centre of force is situated may be considered as coinciding with the nearer vertex of the ellipse, or hyperbola, and with the vertex of the parabola, also the ellipse may be considered as coinciding with its transverse axis, and the hyperbola with its transverse produced, also the parabola coincides with its axis; hence supposing the particle to recede from the centre of force, it may be considered as moving in the axis of the ellipse at the distance (r) from the centre of force, or at the distance (r) from the centre of force in the axis produced, in the case of the hyperbola; and at the distance (r) in the parabola; hence $V=\frac{dr}{dt}$, by substituting this value of V in (10), (11), (12), and by reducing they become $\frac{rdr}{\sqrt{2ar-r^2}}=V''dt$ (13), $\frac{rdr}{\sqrt{2ar+r^2}}=V''dt$ (14), $\frac{rdr}{\sqrt{2pr}}=V''dt$ (15). It may be well to observe that V, V′, V″, &c. are not supposed to have the same values in the three cases treated of; but supposing them to be adapted to any one case, their values are supposed to be altered when they are applied to the other cases, so as to suit those cases also. Put $\cot.\varphi=\sqrt{\frac{2a-r}{r}}$ (16), $\cot.\varphi'=\sqrt{\frac{2a+r}{r}}$ (17), and $\cot.\varphi''=\sqrt{\frac{2p}{r}}$ (18), then (13), (14), (15) are easily changed to $\frac{r^2 \operatorname{cosec.}^2 \varphi d\varphi}{2}=\frac{aV''}{2}\times dt$ (19), $\frac{r^2 \operatorname{cosec.}^2 \varphi' d\varphi'}{2}=\frac{aV''}{2}\times dt$ (20), $\frac{r^2 \operatorname{cosec.}^2 \varphi'' d\varphi''}{2}=\frac{pV''}{2}\times dt$ (21); or by integration (19), (20), (21) become $\frac{Sr^2 \operatorname{cosec.}^2 \varphi d\varphi}{2}=\frac{aV''}{2}\times t$ (22), $\frac{Sr^2 \operatorname{cosec.}^2 \varphi' d\varphi'}{2}=\frac{aV''}{2}\times t$ (23), $\frac{Sr^2 \operatorname{cosec.}^2 \varphi'' d\varphi''}{2}=\frac{pV''}{2}\times t$ (24); S being the sign of integration, and it may be observed that no correction is necessary supposing t to commence when $r=0$. (22), 23), (24) indicate Newton's constructions, (Prin. Vol. I. Sec. 7, prop. 32.) (22) gives his case 1. for (see his fig. 1,) $\frac{P}{2}-\varphi=$ his angle CBD, $r=$CB, $2a=$AB, $r \operatorname{cosec.}\varphi=$BD, and $\frac{r^2 \operatorname{cosec.}^2 \varphi d\varphi}{2}=$ the differential of the area BD, $\therefore \frac{Sr^2 \operatorname{cosec.}^2 \varphi d\varphi}{2}=$ the area BD, the integrals commencing when r or CB$=0$, hence in his fig. 1.

$BD = \frac{aV''}{2} \times t$ (25) or because $\frac{aV''}{2} =$ const. t is as the area BD, or supposing the particle to fall from A, the time from A to B is to the time from C to B as the area of the semicircle ADB to the area BD. In like manner (23) gives his case 2. (see his fig. 2.) the axis AB of his rectangular hyperbola $=2a$, $CB=r$, $AC=2a+r$, and $\cot. \varphi' = \sqrt{\frac{2a+r}{r}} =$ tan. ang. CBD, $\therefore \frac{P}{2} - \varphi' =$ CBD, hence as before the area $BD = \frac{aV''}{2} \times t$ (26), and the time from C to B is as the area BD. Also (24) gives his case 3. supposing that $p=$ the semiparameter of his parabola, (see his fig. 3.) $r=CB$, then $\cot. \varphi'' = \sqrt{\frac{2p}{r}} =$ tan. ang. CBD $\therefore \frac{P}{2} - \varphi'' =$ CBD, hence as before I have the area $BD = \frac{pV''}{2} \times t$ (27), and the time of motion of the particle from C to B is as the area BD. Again, (25), (26), (27), agree with Newton's conclusions, (Prin. Vol. I. Sec. 7, prop. 35,) the areas BD in (25), (26) are equal to $\frac{aV''t}{2}$, in which $a=$ the radius of the circle described by the particle at the distance a, from the centre of force $= \frac{\text{latus rectum}}{2}$ of the circle, or rectangular hyperbola, and $V''t=$ the arc of the circle described by the particle in the time t, $\therefore \frac{aV''t}{2} =$ the area described by the radius vector, a, in the circle (rad. $=a$,) whence his first case is evident; also his second case follows in the same manner from (27), the radius of the circle in this case $=p=$ half the latus rectum of the parabola. Also Newton's constructions of props. 36 and 37, are evident from what has been done, his 37th being equivalent to supposing that V, V′, r in (7) and (8) are given to find a; whence by squaring those equations and writing them in the form of proportions, his proportions will be obtained for finding a, &c. but as these proportions are very simple, I shall here leave them.

ART. XI.—*An easy solution of a Diophantine Problem;* by A. D. WHEELER, Principal of the Latin Grammar School, Salem, Mass.

Problem.—To find two squares, whose sum shall be a square; or in other words, to find rational values for the legs and hypothenuse of a right angled triangle.

Rule.—Take any two numbers, of which the difference is 2. Their *sum* will be the *root* of one square; their *product*, that of the other. Add 2 to the product, just found, and you obtain the root of the *sum of the squares*, or the value of the hypothenuse.

Example.—Take the numbers 10 and 12; then $10+12=22=$ the root of one square, and $10\times12=120=$ that of the other. Furthermore, $120+2=122=$ the root of their sum; since $(22)^2+(120)^2=(122)^2$. These quantities may be *multiplied* by any number whatever, and their *products*, when squared, will still answer to the conditions of the problem.

Demonstration.—Let z represent the smaller number, and $z+2$, the larger. Their sum $z+(z+2)=2z+2$ [A], and their product, $z.(z+2)=z^2+2z$ [B]. Now $(2z+2)^2+(z^2+2z)^2=z^4+4z^3+8z^2+8z+4=$ a square, whose root is $z^2+2z+2=(z^2+2z)+2$ [C] $=$ the product [B] $+2$. Multiplying the expressions [A], [B], and [C], by m, and squaring, we have $m^2(2z+2)^2+m^2(z^2+2z)^2=m^2(z^4+4z^3+8z^2+8z+4)=m^2(z^2+2z+2)^2$, whatever be the values of m and z. Q. E. D.

When $m=0$, and z is an *odd number*, the quantities [A], [B], [C], are *prime* to each other. But when z is *even*, these quantities may be divided by 2, and by no other number. For, if we suppose the quantity [B] to be divisible by n, then, when n is a prime number, either z or $z+2$ must be divisible by it. Because, if a prime number will divide *neither factor*, it cannot divide the *product*. (Euler, App. 10). But since the difference between z and $z+2$ is only 2, the number n, when *greater than* 2, cannot divide them both; and, consequently, cannot divide the quantity [A]. (Bonnycastle, p. 145). Again if [B] and [C] are divisible by n, then the parts of [C], (z^2+2z) and 2 may be divided by n. But, it is plain, that this cannot be done, unless, as before, $n=2$.

If n be not a prime number, it is necessary to remark, that all compound numbers may be resolved into prime factors, each of which is capable of dividing the same quantities as its compound. If therefore no prime number will divide a given quantity, no number whatever will divide it.

Now, assigning to z integral values, and dividing by 2, when z is an even number, we form the following table.

	[A]	[B]	[C]		[D]	[E]	[F]
	$2z+2$	z^2+2z	z^2+2z+2				
$z=0$,	2	0	2,	dividing by 2,	1	0	1
$z=1$,	4	3	5				
$z=2$,	6	8	10	" "	3	4	5
$z=3$,	8	15	17				
$z=4$,	10	24	26	" "	5	12	13
$z=5$,	12	35	37				
$z=6$,	14	48	50	" "	7	24	25
$z=7$,	16	63	65				
$z=8$,	18	80	82	" "	9	40	41
$z=9$,	20	99	101				

This table may be extended at pleasure; and since each set of numbers may be multiplied by m, it appears, first, that the proportion between the sides of rational triangles may be infinitely varied; and secondly, that different values may be indefinitely assigned when the proportion between the sides remains constant.

The following properties of the numbers in the foregoing table are worthy of notice.

1. If the numbers in the column [A] be subtracted from those in the column [C], the difference will be a square. Ex. $101-20=81$.

Demonstration. $(z^2+2z+2)-(2z+2)=z^2$ a square.

2. If 1 be added to the numbers in the column [B], the sum will be a square. Ex. $3+1=4=\square$, $8+1=9=\square$ &c.

Demonstration. $(z^2+2z)+1=z^2+2z+1=\square$.*

3. If 1 be taken from the numbers in the column [C], the remainder will be a square. Ex. $101-1=100=\square$, $82-1=81=\square$ &c.

Demonstration. $(z^2+2z+2)-1=z^2+2z+1=\square$.

4. The numbers in the column [F] are all composed of the sum of 2 squares, taken, two and two, in the regular series 1, 4, 9, 16, &c. Ex. $5=1+4$, $13=4+9$, $25=9+16$, &c.

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* This is the demonstration of a property stated some weeks since in the Albany Evening Journal, and thence copied in the National Intelligencer.

Demonstration. These numbers are half of the corresponding numbers in the column [C]. The expression for them, is therefore $\frac{z^2}{2}+z+1$, which is composed of the two squares $\frac{z^2}{4}$ and $\frac{z^2}{4}+z+1$.

Art. XII.—*Halos.*—1. Solar.

*Some account of an Atmospheric Phenomenon, seen a few years since, in the County of Otsego. (From a paper read before the Albany Lyceum.)**

Communicated by S. DeWitt Bloodgood, Esq.

On the morning of the 7th of February, 1823, a very brilliant parhelion, or halo, round the sun, with anthelia, or mock suns, in the circumference of the circle, was observed by many persons in the county of Otsego. The writer, in company with some gentlemen of this city, (Albany) was travelling in the town of Decatur, on the road to Cherry Valley, when, at about 8 o'clock in the morning of that day, the phenomenon alluded to, was distinctly visible on the right hand side of the road. A large and brilliant circle surrounded the sun, and at the extremities of the horizontal diameter were two mock suns, very bright, with conical tails, opposite the true sun in the center. The day was cold and stormy, and the air was filled with dry and shining particles of snow which apparently hung over the brow of the hill, upon which the road ran. The sun had gained 20 degrees of altitude. The wind was due West, and the halo was very large. It is impossible at this time to ascertain its size, but it appeared to be of great magnitude, and very near the spectator. It lasted about ten minutes, and then vanished. The weather for the two or three following days was cold and stormy.

The writer of the above statement regards the explanations hitherto given of such phenomena, as not altogether satisfactory, or rather, that of some of them no real explanation has been given. Water

* The explanatory remarks are abridged from a manuscript communication to the Editor.

in the atmosphere is concerned in their production; in the case of hail, he supposes that the spherical drops of water congeal into the same form, and that the spicular, prismatic and stellar form of snow flakes, depends on crystallization from the state of vapor. The light which comes to the eye, in cases like that described above, passes through a compound medium.

A cloud of rain, snow or ice intervenes between the eye and the luminous body. The cloud is near or distant.

It will be large in direct proportion to the angle of vision which it subtends, and the diameter will be in an exact ratio to the visual angle. The various sizes of these halos are explained by the case of a rainbow, the continuity of whose arc depends on the continuity of the cloud, and the edge of the cloud limits the extent of the refraction (for there the medium is broken off, and is at an end); so it follows that the size of the cloud will control the limits of the reflection in the corresponding case of a halo, or simple corona. Suppose the sun elevated, and a cloud of dry, glistening snow intervenes between it and the spectator. The whole mass becomes reflective like water, or like glass, or like a semi-opaque body. At the extremity of the cloud, or at the densest part, the rays will be most strongly attracted and reflected, since it is proved that light is subject to this general law, and they will represent a circular image, for they proceed in right lines from a spherical body.

Although refracted by the earth's atmosphere, they move in equal parallelism, as well after as before refraction. All the direct rays from the sun passing through the cloud would represent that object, while those striking the cloud, in other angles, would have the angles of incidence and reflection equal, or in other words, would be reflected to different points of sight, and give to other spectators at the other positions a similar image. If the circle be white, the rays, as possessing equal refrangibility, are called homogeneous, if colored, heterogeneous, because unequally refrangible. The halo seen on the 7th of February was of pure white, the rays were homogeneous, and the medium transmitting them was consequently of the same refracting and reflecting power throughout, a fact which goes very far to support the theory already projected.

We have heard of many facts which show that entire clouds become the media of reflection. On the Alps the figure of a man is seen by the wondering shepherds. In Sicily the Fata Morgana are well authenticated, and within our own knowledge a fact exists which puts the matter entirely beyond dispute. While Commodore Hardy was lying off Boston, during the late war, his whole ship's crew observed, during a particular state of the atmosphere, the figure of a man, resembling a sailor of a colossal size reflected in the heavens.

If the particles of the atmosphere had reflected each its respective image, the object would have been confused, shapeless and obscure.

The halo being thus accounted for, the anthelia, or mock suns yet remain to be explained. As yet nothing of this kind has been attempted. The best works, within our reach, are silent on the subject, but yet it is evident that at the particular points, where they are seen, a greater collection, and a greater reflection of homogeneous rays must take place than at any other.

The idea most obvious is this, that those direct rays of the sun, which would otherwise have passed off uncollected, are attracted to the edges of the cloud, drawn within its influence, and then refracted and reflected to the eye of the spectator.

2. Lunar.—*West Point, March* 27, 1831.

In observing a beautiful halo around the moon, on the night of the 20th inst., I was led to consider the cause of this remarkable phenomenon; I noticed that the inner part of the halo was about 10° from the moon, that its breadth was about 3° or 4°, and that the brightest colors were in the middle of the ring. Near the edge of the moon the sky was of its natural color; as well as I could determine, the color of the concentric rings, which formed the halo, were as follows, (beginning with the inner ring,) pale blue, yellow, orange, and pale blue again.

That this and similar phenomena are occasioned by the watery vapors in the atmosphere, is highly probable, and indeed it is rendered almost certain from the following experiment, which I performed a short time after I observed it. I took a clear and smooth piece of glass with parallel faces, and after gently blowing the breath upon it, I held it up so as to look through it at the moon; by means of the aqueous vapor which was scattered in very small globules over the surface of the glass, the moon's rays were refracted, producing all the different colors which I had seen in the halo. The variety and brightness of the colors can be modified by the quantity of vapor which is attached to the glass, and the size of the ring will depend of course upon its distance from the eye. Now it is well known that since the specific gravity of watery vapor (at common temperatures) is less than that of the air, it will ascend from the surface of the earth, until the decrease in the density and temperature of the atmosphere causes it to remain suspended in equilibrio; and this it may do too, in quantities insufficient to destroy the azure of the sky. From these facts, we may very naturally conclude that (the medium of the atmosphere representing the glass,) the refraction caused by the particles of water, suspended at a great distance in the air, will produce all the appearances indicated by experiment.

And it may be observed further, that the size and brightness of the halo will depend upon the distance of the vapor from the earth, and the quantity of it suspended in the air.

Art. XIII.—*Notices of Eminent Men deceased in Great Britain.*

1. J. S. Miller,* A. L. S. *Curator of the Museum of the Bristol Philosophical Institution*, was a native of Dantzig, the only son of truly respectable parents. He was designed by his father for commercial pursuits, and served an apprenticeship with M. Dennies, a merchant of his native town. He came to England in 1801, with a full resolution of proceeding to America, and with letters of recommendation to persons in that country. The vessel in which he expected to cross the Atlantic had sailed on the day before his arrival; and being thus detained in Bristol, he formed connections by which he was finally induced to alter his purpose and to fix his abode in this city. Here he endeavored to establish himself in mercantile business, but his efforts were unsuccessful; and it happened, unfortunately for his prospects in life, that Dantzig was at this period overrun and pillaged by the French. His father's property shared the common fate; and of fifteen hundred pounds which had been left to Mr. Miller, nothing ever came into his possession except a box of valuable coins, which was concealed during two years in a church, and a very inconsiderable sum of money. He now devoted himself entirely to scientific pursuits, for which he had shown a strong inclination from his early youth, and he soon acquired very extensive in-

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* Phil. Mag. for January, 1831.

formation in various branches of natural history. Some curious researches in entomology introduced him at an early period to the acquaintance of Dr. Leach, and this was the first occasion on which his talents became known beyond the circle of his personal friends. The prospect of succeeding Dr. Leach at the British Museum opened a new field to his mind; and although he was frustrated in this expectation by the appointment of Mr. Children, he applied himself from this time with increased energy to his researches in natural history. An investigation of the structure and nature of the organic remains of the *Encrinus*, for which the vicinity of Bristol affords so remarkable a field, now became his favorite pursuit. It was while he was engaged in the publication of his well-known work on the *Crinoïdea*,* that he became known to the Rev. W. D. Conybeare, by whom his merit was soon distinguished and very highly appreciated. As the work was going through the press, Mr. Conybeare kindly undertook to revise it, and, by correcting the peculiarities of a foreign idiom,† to render it more acceptable to the public than it might otherwise have been. In this publication Mr. Miller had to surmount many difficulties; and although it became the means of spreading universally his reputation as a profound and accurate naturalist, it was to him a source not only of present expense, but of ultimate pecuniary loss. This may be attributed in part to his great liberality of disposition. I am informed that he gave away not less than a hundred copies of his work, principally to individuals whom he supposed unable to purchase it. His pen was always ready and his services energetic in any scientific undertaking in which they were requested, as the many letters of thanks and works presented to him in consequence of such assistance will sufficiently testify. Notwithstanding the difficulties he experienced at his first publication, he was not discouraged. He contemplated and had arranged in his mind the materials for a second work on fossilized corals, and likewise an appendix to that on the *Crinoïdea*. There was scarcely a department of natural history to which he had not directed his mind with zealous and intense application; and there is no doubt that he

* There is a copy of this work in the library of Yale College, and this is a work which should be attentively studied by those who examine our transition and early secondary limestones.

† This, however, was strictly confined to the correction of such idiomatic inaccuracies as might have obscured the sense to an English reader; in all other cases it was considered in every respect desirable scrupulously to preserve unaltered the author's own expressions.—W. D. C.

would have achieved more, as an original discoverer, than he has actually performed, if his time and exertions had not been engrossed, during the last years of his life, by his occupations in the Museum of the Philosophical Institution of Bristol, of which he was the curator from the period of its establishment.

Mr. Miller's constitution of body, though not robust, was healthy, and during a period of twenty seven years he had never a day of severe indisposition. His cheerfulness and temperance were remarkable. The unceasing activity of his mind was apparently too great for the physical energy of his body; and the confinement to which he was of necessity subjected, in consequence of his appointment in the Institution, probably contributed to undermine his health, which began to give way about three years before his death. He was married in the year 1806, and has left a widow and three sons.

As a naturalist, Mr. Miller was well fitted by the habits of his mind to cooperate in the researches of an age, of which it is the peculiar merit to obviate the reproaches once, perhaps justly, cast against mere systems of classification, and to found such arrangements upon the just and philosophical grounds afforded by the exact determinations of science, and the general principles of physiology and comparative anatomy. The labors of Baron Cuvier may be cited as the great model in this line; but among those who in this country have followed the same course, the subject of the present memoir assuredly deserves very favorable mention. To an acuteness of mind which readily seized on general relations, he joined the most indefatigable patience of laborious investigation,—a quality particularly requisite in the branch to which he especially directed his attention; viz. the elucidation of the history of the organic remains which are preserved in our strata in a fossilized state. In this state individual specimens generally occur in a more or less imperfect condition, so that the real type of the organization can seldom be ascertained without the most careful comparison of many particular relics. They are likewise in many instances so imbedded in the solid rock, that the most essential parts are concealed, and cannot be detected without the nicest dexterity of manual operation. When these circumstances are taken into the account, we may fairly appreciate the labor and talent necessary to produce such a work as Mr. Miller's account of the fossil *Crinoïdea.* This family of organic bodies, from the delicate beauty and interesting character of many of its specimens, had long excited the attention of naturalists; but still our whole knowledge on the subject, previously to the appearance of Mr. Miller's work, was in the highest degree vague and indeterminate. His researches, however, have established in the most complete manner, and have placed in every respect in the fullest and clearest light, the whole history and relations of this curious family. He has demonstrated its arrangement into four divisions, including nine genera, and more than twenty species. Of each species he has developed the whole anatomy with the same exactness as if they had been recent objects easily preserved, overcoming the many and great obstacles which, as it has been always noticed, the fossilized state presents to such inquiries. Persons who are at all aware of the complicated structure of the *Crinoïdea*, and the numerous articulations which enter into the composition of each individual, must feel all the arduousness of such a task; but those only can fully appreciate the extreme care with which it has been performed, who have had an opportunity of examining Mr. Miller's collection of original specimens now deposited in the Museum of the Bristol Institution, and of comparing these with the illustrations published in his work.

The great merit of this treatise secured its immediate reception as the standard work on the subject, by all the scientific writers interested in similar pursuits on the continent as well as in this country; and reference is now uniformly made to it as such. The author had intended to follow up this work, as before mentioned, by a similar examination of our coralline remains; but it is feared that he has left no papers on this branch at all prepared for publication. A paper of his, published in the Transactions of the Geological Society, contains very valuable contributions towards the history of our fossil belemnites, and has been most favorably referred to by the French author who has subsequently published the standard monography of that department.

Mr. Miller's talents have been highly estimated by the ablest of our naturalists and geological writers. Professor Blumenbach, Baron Cuvier, MM. Latreille and D'Aubigné, have expressed in letters to him high commendation of his works. Professor Buckland obtained his assistance in arranging the valuable collection of organic remains belonging to the Ashmolean Museum at Oxford. The same Professor, in his very interesting paper on the recent discovery in this country of fossil remains belonging to the flying reptile the *Pterodactylus*, mentions that Mr. Miller first suggested to him the possibility, thus confirmed, that the fossil bones commonly supposed to belong to birds really appertained to that animal. And Mr. Conybeare, while drawing up the lists of the organic remains in our strata, which are given in his "Outlines," was in the common habit of appealing to Mr. Miller's authority.

In surveying the results of Mr. Miller's scientific acquirements and of his exertions, we must not forget the important benefits rendered by him to the Museum of the Institution of which he was Curator. It may safely be affirmed, that the history of similar collections, does not present another instance in which so rapid a progress has been made in accumulating the varied stores connected with such undertakings; and the rapidity of this progress must undoubtedly be ascribed in a great measure to the energy and zeal of the Curator in the service, and to the interest which he so well knew how to communicate to those with whom he came into intercourse.

2. Major James Rennell* was descended from an ancient and respectable family in Devonshire, said to be of Norman origin. His father was a Captain in the Royal Artillery, and fell at the siege of Maestrich. James Rennell was born at his father's house, Upcott near Chudleigh, in Devonshire, on the 23d of December, 1742. He entered on the naval service of his country at a very early age, where his spirit and exertions soon attracted the notice of Sir Hyde Parker, with whom he sailed in the Brilliant frigate to India. After the conclusion of peace, his eager desire for active service induced him to quit the navy, and he obtained a commission in the corps of engineers belonging to the East India Company. His zeal and ability in discharging the duties belonging to this station obtained for him the friendship of many superior officers, and especially of the great Lord Clive; and he was soon promoted to the station of Surveyor General in Bengal.

The fatigues attached to this civil employment were sufficient to exhaust the strength of any European constitution, conducted as were the surveys, with indefatigable industry, along the banks of the great rivers, periodically overflown and perpetually damp. But these were not all: Major Rennell in encountering dangers which are inseparable from military renown, had suffered wounds so severe that he was, I believe, twice left exposed on the field of battle, and never recovered from their effects up to the latest period of his life.

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* This notice and those that follow, are taken from the address of Daveis Gilbert, Esq. Pres. of the Roy. Society, at their anniversary, Nov. 30th, 1830.

These altogether compelled his return to England, and alone prevented him from attaining the highest military stations.

Retired to private life, the whole energies of his mind were directed to scientific and literary pursuits. We have, founded on his exertions in India: An Atlas of Bengal.—A Map of the Mogul Empire.—Marches of the Army in India.—A Map of the Peninsula.

But the mental powers of Major Rennell were far from being confined to one region of the world.

We have from his pen a work on the Geography of Africa. And with a vigor of intellect that may well call to our recollection the greatest of the Roman censors, he acquired at an advanced age a competent knowledge of Greek for consulting the early writers in that language, and gave to the world, The Geographical System of Herodotus, including the Expedition of Darius Hystaspes to Scythia; The Site of Babylon; The Temple of Jupiter Ammon; The Periplus of Africa, &c.; and A Dissertation on the Locality of Troy.

The attention of this great investigator of every thing connected with the surface of our globe, extended itself from mountains and plains to the waters of the ocean; and produced a most curious investigation of the currents prevalent in the Atlantic, and of accumulations caused by certain winds in the English Channel.

And lastly, I would mention a very ingenious mode of ascertaining distances, and connecting with their bearings the actual localities of spots in the Great Desert, by noting the average rate at which camels travel over those worlds of sand.

This is a very imperfect catalogue of the works published by Major Rennell; and I am happy to add that several more exist in manuscript, destined, we may hope, at no distant time, to appear.

Major Rennell has been honored by the Copley medal from this Society; by the gold medal from the Royal Society of Literature; he was a corresponding member of the Institute of France; and a member of various other societies.

Our regret for such a man, exerting his intellectual powers with so much energy and to such useful purposes, throughout the course of a long life, and up to his eighty-eighth year, must always be strong and sincere; but we console ourselves with the reflection that he had attained the utmost ordinary limit of human life, amidst the respect and esteem of all who knew him, and that his memory is revered.

3. Mr. Chenevix was undoubtedly a man of considerable ability, acquirement and industry. We have from him seven different communications to the Philosophical Transactions:

An analysis of the arseniates of copper.—Observations on Dr. James's powders, with a method of preparing a similar substance in the humid way.—Observations and experiments upon oxygenated and hyperoxygenated muriatic acid.—An analysis of corundum.—Observations on the chemical nature of the humors of the eye.—Inquiries concerning the nature of a metallic substance, under the title of Palladium.—On the action of platinum and mercury on each other.

In the latter years of his life, which could not have reached threescore, he appears to have abandoned chemistry, and to have fallen on speculations wholly unworthy of being noticed from this place.

4. Mr. Smithson, then called Macie, and an undergraduate, had the reputation of excelling all other resident members of the University in the knowledge of chemistry. He was early honored by an intimate acquaintance with Mr. Cavendish; he was admitted into the Royal Society, and soon after presented a paper on the very curious concretion frequently found in the hollow of bambû canes, named, *Tabasheer*. This he found to consist almost entirely of silex, existing in a manner similar to what Davy long afterwards discovered in the epidermis of reeds and grasses.

Mr. Smithson enriched our Transactions with seven other communications:—A chemical analysis of some calamines.—Account of a discovery of native minium.—On the composition and crystallization of certain sulphurets from Huel Boys in Cornwall.—On the composition of zeolite.—On a substance procured from the elm-tree, called *Ulmine*.—On a saline substance from Mount Vesuvius.—Facts relative to the coloring matter of vegetables.

He was the friend of Dr. Wollaston, and at the same time his rival in the manipulation and analysis of small quantities. *Αγαθη δ' ερις ἠδε βροτοισι.* Mr. Smithson frequently repeated an occurrence with much pleasure and exultation, as exceeding any thing that could be brought into competition with it,—and this must apologize for my introducing what might otherwise be deemed an anecdote too light and trifling on such an occasion as the present.

Mr. Smithson declared, that happening to observe a tear gliding down a lady's cheek, he endeavored to catch it on a crystal vessel: that one-half of the drop escaped, but having preserved the other half, he submitted it to reagents, and detected what was then called microcosmic salt, with muriate of soda; and, I think, three or four more saline substances, held in solution.

For many years past Mr. Smithson has resided abroad, principally, I believe, on account of his health: but he carried with him the esteem and regard of various private friends, and of a still larger number of persons who appreciated and admired his acquirements.

5. Mr. Henry Browne.—No one, I believe, was ever more distinguished in the important station of commanding those vessels which secure to England the commerce of nations unknown to former ages; nor did any one more largely contribute towards introducing the modern refinements of nautical astronomy, which skillfully pursued, and under favorable circumstances determine the place of a ship with greater accuracy, than what in the early part of the last century would have been thought amply sufficient for headlands, roadsteads, or harbors of the first importance. And I cannot omit this opportunity of congratulating all those who addict themselves to astronomical pursuits, or who feel an interest in the perfection of geography and navigation, on the great improvements recently suggested and likely to be made in our national ephemeris; improvements which, in part at least, I hoped to have got adopted twelve years ago: but now under more fortunate auspices I flatter myself that they will be carried into execution, and their practical advantages cannot fail of being very great.

Retired to private life, Mr. Browne usefully amused his declining years by a continuance of his favorite pursuits; and up to the latest period of his life he patronised, encouraged, and promoted practical astronomy.

6. The late Duke of Atholl demands also attention, not on account of his high station, but as a patron of science, and especially of that most important, interesting and rapidly improving branch of science, geology.

Geology, deriving its birth from the continent of Europe, seems to have been drawn to this island by the genius of Dr. Hutton, and here to have grown with the vigor of youth under the fostering hands of many who now hear me, and also of a gentleman to whom the Duke of Atholl afforded every assistance to be derived from his large property, and his extensive influence.

The Duke of Atholl has also at once enriched and decorated his country; and afforded an instructive example to all other proprietors of similar wastes, by clothing tracts of land, incapable of a different cultivation, with the most valuable of the pines. His forests of larch, which have acquired maturity in the course of a single life, promise not merely to supersede the use of foreign deal, but to allow of our reserving the tree always esteemed the peculiar pride and boast of this island, for the construction of ships of war on the largest scale.

7. Sir Thomas Lawrence stands proudly preeminent among native artists, and perhaps among artists of the whole world, in that department to which he exclusively applied the powers of his genius; nor would, I am persuaded, the great painter of the preceding age have been unwilling to admit him as his equal in the delineation of portraits—not the servile copies of individual features, but poetic likenesses, where every excellence is heightened, where the mind is depictured, and where the particular person seems to embody the class of virtues, of intellectual powers, or of amiable qualities designating the moral order in which he is arranged.

This constitutes unquestionably a department of historical painting, not inferior, perhaps, nor even less difficult of acquirement than the others, where all is imaginary.

The name of Reynolds must, and for various reasons, ever will stand first on the list of those who have cultivated in this country the whole extent of an art, the most refined, requiring talents the most rare, and at the same time the most delightful of all that have sprung from the human mind;—but that of Lawrence will be hailed by the Academy as their *Spes altera*, and their *Decus gemellum.*

Art. XIV.—*Observations and Experiments on the rapid production of Steam in contact with metals at a high temperature;* by Walter R. Johnson, Professor of Mechanics and Natural Philosophy in the Franklin Institute, Philadelphia.

By a reference to the number of this Journal for January of the present year, the reader will find an account of the method of performing the experiments detailed in the following pages. From the data there furnished, we may readily calculate the quantity of steam, of atmospheric pressure, which would be generated by any known quantity of iron that should become red hot. Thus, should a boiler twenty feet long and thirty inches in diameter, with a returning flue one foot in diameter, be constructed of iron one fourth of an inch thick, the exterior shell would give a curved surface of 157 square feet, and as the specific gravity of good boiler iron is 7.770, it must weigh 10 pounds 2 oz. to the square foot. The whole exterior cylinder would therefore weigh 1582 pounds, exclusive of any allowance for rivets and for double thickness at the joints. The weight of the interior shell or flue will be 636 pounds. As the fire is supposed to act on *one half* of the outer shell, and on the *whole* of the flue, there would, in case of the heeling of a boat, sufficiently to throw all the water out of one boiler, be no less than $636+\frac{1582}{2}=1427$ pounds of iron exposed to the direct action of the fire, and liable to become red hot. By the *first series* of experiments detailed in the paper above alluded to, (page 296,) we see that one pound of atmospheric steam will be generated from water at 212° by every nine pounds of iron, at a low red heat, in day light; consequently, the metal above supposed would be sufficient to produce $\frac{1427}{9}=158\frac{5}{9}$ lbs. of steam from water at 212°, whenever a change of position should favor its influx in sufficient quantity to cover, either by actual submersion, or by violent agitation, the surfaces of the flue and lower arch of the boiler. To calculate the effect of this weight of vapor, we must compare its bulk with the *steam-room* left in the boiler. The whole interior capacity of the latter is but 82.4 cubic feet; but in the condition of things now supposed, a small part only of this space is occupied by water.

The bulk of steam becomes known by comparing its specific gravity with that of the water from which it is formed. Thus, assuming the specific gravity of common air, at 60° Fah. to be .00122 of that of water at the same temperature, as determined by Biot & Arago, the specific gravity of steam compared with air at 60° being .481 to 1, the specific gravity of steam compared with *water at that temperature*, is .00058682. As $158\frac{5}{9}$ lbs. of water at 60° measure $\frac{158.5}{62.5}=2.536$ cubic feet, the *atmospheric steam*, which can be obtained from it will be $=2.536\div.00058682=4321$ cubic feet; which, divided by the capacity of the boiler, gives $\frac{4321}{82.4}=52\frac{362}{824}=52\frac{3}{7}$, nearly, for the number of atmospheres of pressure, supposing the whole to be condensed and confined in the single boiler, within which we have shown that it may be generated. This would give 786 lbs. to the square inch. But upon the supposition that while heat continues to be applied to the boiler, from which the water is drained, its connexion with others remains uninterrupted, nearly the usual pressure will be maintained within it. This pressure may be stated at 8 atmospheres; so that by adding the $52\frac{3}{7}$ derived from the over-heated metal we should have no less than $60\frac{3}{7}$ atmospheres or 906 lbs. to the square inch for the resulting elasticity. This is upon the assumption that steam obeys the same law in regard to its relative bulk and elasticity, as that which governs atmospheric air. But if it do not follow that law, there is no probability whatever that the pressure would be *less* than in the direct ratio of the density.

Before proceeding to the detail of experiments on other metals, I think it proper to present the following series of results, in which my main object was to ascertain, accurately, the rapidity of cooling of iron from incandescence down to 212°, taking into consideration the temperature of the water, both at the beginning and end of the experiment, its weight in some cases, and the relation, in all cases, between the weight of metal and the amount of its generating surface. These experiments were performed in an apparatus similar to that described in my former communication, but furnished with an attached thermometer to mark with accuracy the temperatures attained. The result, as will be seen, is, that the times approximate to an inverse proportion to the generating surface. This proportion will not be found to obtain, where part of the heat was employed in raising temperature, and a part in generating steam. The time demanded for cooling a given mass of metal from redness to 212°, by the latter process, must be greater than by the former, both because the temperature of the liquid, which is to receive heat, is greater, and the difference between it and the metal less, and because the surface of the iron is momentarily denuded of water and prevented from acting by a constant and uniform communication. The temperature, in a few instances, was calculated by multiplying the weight of water by the number of degrees through which it was heated, and dividing the product by the weight of metal multiplied into its specific heat. To the quotient was, of course, added 212°, the temperature at which the metal was withdrawn after every trial.

FOURTH SERIES.

Showing the time in which iron, in a state of incandescence, may be reduced to the boiling temperature, either by heating water from different points, by generating steam, or by both operations in succession.

Quality and form of the masses of metal.	No. of experiment.	Weight of water.	Relation of *surface to weight* of metal.	Temperature of water at the beginning.	Temperature attained at the end.	Time in passing from incandescence to 212°.	Calculated temperature.	*Remarks on observed temperatures.*
		lbs.	*oz. sq.in.*	°	°	″	°	
Cast iron cylinder, 168 oz. 86.25 sq. in.	1	26	1 : .513	60	138	77	1805	Very bright red.
	2	unc.	1 : .513	60	140	81		Comparable.
	3	unc.	1 : .513	120	212	71		Clear red.
Cast iron cylinder, 150 oz. 77.25 sq. in.	4	15	1 : .515	55	190	126		Bright red.
	5	21.5	1 : .515	60	144	117	1801	Very bright red.
	6	unc.	1 : .515	60	212	114		Bright red.
	7	11	1 : .515	76	180	95	1218	Above comparable.
Cast iron cylinder, 60 oz. 37.5 sq. in.	8	unc.	1 : .625	60	100	90		Very bright.
	9	10	1 : .625	80	212	112		Do.
	10	unc.	1 : .625	212	212	128		Very bright, continued red in the water 82″, and ebullition ceased in 46″ afterwards.
	11	14	1 : .625	180	212	110		Bright red.
Rolled plate of wr't iron 3-16 in. th'k, 144 oz. wt. 395 sq. in. surface.	12	Quantity of water not observed.	1 : 2.75	60	212	23		Comparable.
	13		1 : 2.75	100	212	23		Do.
	14		1 : 2.75	128	212	33		Full red.
	15		1 : 2.75	175	212	41		Bright red.
	16		1 : 2.75	180	212	25		Comparable.
	17		1 : 2.75	212	212	25		Do.
	18		1 : 2.75	212	212	28		Do.
	19		1 : 2.75	212	212	36		Full red.
Cylinder of wr't iron weighing 16 oz. and comprising a surface of 18.2 square inch.	20	1.375	1 : 1.14	32	133	20	1462	Clear red.
	21	1.375	1 : 1.14	40	127	19	1288	Rather less red, but above comparable.
	22	1.375	1 : 1.14	72	172	21	1449	Clear red.
	23	1.375	1 : 1.14	100	212	25		Do.
	24	1.375	1 : 1.14	112	212	30		Do.
	25	1.375	1 : 1.14	126	212	31		Do.
	26	1.375	1 : 1.14	148	212	36		Do.
	27	1.375	1 : 1.14	168	212	43		Do.
	28	1.375	1 : 1.14	190	212	75		Do.
	29	1.375	1 : 1.14	200	212	77		Do.
	30	1.375	1 : 1.14	212	212	78		Do.

FIFTH SERIES,

With hollow cylinders of copper, presenting 149 square inches of generating surface—water kept at 212°.

No. of experiment.	Weight of metal in ounces avoirdupois.	Time in seconds.	Ounces of steam produced.	Decimal part of an ounce of steam to each ounce of metal.	Ounces of metal to each ounce of steam.	Heat observed.	Remarks.
1	158.50	75	9.875	.0636	16.050	Black.	
2	158.25	50	10.5	.0663	15.071	Black.	
3	157.	70	12.25	.0780	12.816	Reddish by dusk, but not in day light.	
4	159.	70	13.5	.0846	11.777	Do.	
5	159.25	73	14.25	.0895	11.175	*Comparable* dull red.	
6	159.	45	14.25	.0896	11.158	Do.	Immersed at once.
7	158.	55	14.5	.0911	10.896	Do.	
8	156.75	66	14.5	.0925	10.810	Do.	
9	158.75	75	14.75	.0929	10.762	Do.	
10	159.75	75	15.	.0939	10.650	Clear red.	
11	157.5	65	15.25	.0967	10.327	Do.	
12	157.75	70	17.25	.1093	9.145	Bright red.	

The mean amount of metal to the ounce of steam in the five experiments marked *comparable* in the above table, is $10\frac{96}{100}$ ounces, which may be assumed as 11 without sensible error.

SIXTH SERIES,

To determine the quantity of steam yielded by given weights of cast brass at red heat, when plunged into water at 212°.

No. of experiment.	Weight of brass in ounces.	Time in seconds.	Ounces of steam produced.	Weight of steam to an ounce of metal.	Ounces of metal to one ounce of steam.	Heat observed.	Remarks.
1	176	70	15.75	.0895	11.809	Red only in the dark.	Immersed at once.
2	176	120	16.5	.0943	10.666	*Comparable*, (dull red.)	Do. by degrees.
3	175	60	16.75	.0958	10.448	Do.	Do. at once.
4	176	105	17.	.0966	10.353	Do.	Do. more gradually.
5	175	120	17.25	.0985	10.145	Do.	Do. slowly.
6	175	120	17.25	.0985	10.145	Do.	Do. Do.
7	175	180	18.	.1028	9.722	Clear red.	Do. Do.
8	176	75	19.	.1085	9.263	Full red.	Do. at once.
9	176	120	22.	.1250	8.000	Bright red.	Do. gradually.

The five experiments which were made at a dull red heat in day light, and which were therefore marked *comparable*, prove that, on an average, one pound of steam requires $10\frac{35}{100}$ pounds of cast brass of that temperature for its production. It was observed that the violence of agitation, when brass was employed, appeared to be much greater than when similar masses of iron were the subjects of experiment. This was attributed to its higher conducting power. A repetition of this series might not exhibit precisely the same results, unless the specimens employed should have the same proportion of ingredients and the same specific gravity.

SEVENTH SERIES,

With ingots of standard silver, of various weights, from 21½ to 195½ ounces avoirdupois.

No. of experiment.	Weight of silver in ounces avoirdupois.	Time in seconds.	Weight of steam produced.	Parts of steam to one ounce of metal.	Ounces of metal to one ounce of steam.	Heat observed.	Remarks.
1	195.5	120	10.	.0511	19.550	*Comparable*, (dull red.)	Immersed by degrees.
2	26.5	30	1.375	.0519	19.272	Do.	Do. at once.
3	26.5	33	1.5	.0566	17.666	Do.	Do. Do.
4	26.5	30	1.75	.0660	15.143	Clear red.	Do. Do.
5	26.5	32	1.75	.0660	15.143	Do.	Do. more gradually.
6	41.2	50	3.0625	.0740	13.453	Do.	Do. at once.
7	41.2	55	3.125	.0758	13.120	Full red.	Do. Do.
8	195.5	130	15.	.0767	13.033	Do.	Do. gradually.
9	21.5	30	1.75	.0814	12.286	Do.	Do. at once.
10	41.2	68	3.5	.0849	11.771	Do.	Do. gradually.
11	26.5	30	2.5	.0943	10.600	Bright red.	Do. at once; silver beginning to soften.

From a comparison of the three experiments marked *comparable*, in the above table, it appears that about $18\frac{83}{100}$ pounds of standard silver will be required for generating one pound of steam.

EIGHTH SERIES,

With an ingot of pure gold, weighing 14 lbs. $8\frac{1}{4}$ oz. avoirdupois,* and other circumstances as in preceding series, the following results were given.

No. of experiment	Weight of gold in oz. avoirdupois.	Time in seconds.	Weight of steam produced.	Weight of steam to unit of metal.	Ounces of metal to unit of steam.	Heat of metal.	Observations.
1	232.25	100	2 oz.	.0086	116.125	Red in the dark.	The water had remained exposed a short time, and probably lost a few deg's before this exp.
2	232.25	120	5 "	.0215	46.450	Comparable.	Plunged by degrees.
3	232.25	125	6 "	.0258	38.708	Comparable.	Do.

The mean, of the two experiments, made at the temperature of comparison, is $42\frac{55}{100}$ pounds of metal to each pound of steam. The extremely low specific heat of gold, renders necessary every precaution formerly detailed, in regard to avoiding loss of temperature in the water between two successive experiments, and also demands peculiar accuracy and dispatch in the process of weighing. After all the efforts, which were made to insure a correct result, it may have happened that a few degrees of heat, in the gold, were expended in *raising temperature*, and a corresponding deficiency in the quantity of heat *of elasticity* may have been the consequence.

The following summary exhibits a comparative view of the several metals submitted to trial, as shown in the preceding series, indicating the mean result of those experiments in each series which were made at the comparable temperature.

From all the preceding series it appears that at comparable temperature, each pound of steam requires for its production of

Cast iron, - - -	$8\frac{1}{4}$	pounds
Wrought iron, - - -	9	"
Wrought copper, - -	$10\frac{35}{100}$	"
Cast Brass, - - -	$10\frac{96}{100}$	"
Standard silver, - -	$18\frac{83}{100}$	"
Pure gold, - - -	$42\frac{58}{100}$	"

* The above mentioned mass of gold, at the mint valuation of $4\frac{1}{25}$ cents per grain, was worth $4105.448. For the use of this, as well as of several ingots of silver, and for other conveniences in these experiments on the precious metals, I am indebted to the politeness of Dr. Moore, superintendent—Mr. Eckfeldt, chief coiner—and other officers of the United States' Mint.

If the temperature assumed for comparison be precisely as much above 212° as is equal to the number of degrees of heat, which become latent in water while it passes into steam, it is evident that any substance at *comparable* temperature, *and possessing the same specific heat as water*, would generate its own weight of steam in cooling down to 212°. But if its own specific heat be less than that of water, its weight must be proportionally increased, and then the effect of cooling will be the production of the same weight of steam as before supposed. Hence as the *specific heat* is directly proportional to the quantity of *steam* which a given weight of metal would produce, the latter may, at a known temperature, be assumed as a measure of the former. By the following comparison it will be evident that the temperature adopted in these experiments *was* nearly identical with that which I have above alluded to, and which exceeds 212°, by the amount of latent heat (990°) in a unit, by weight, of steam.

	Steam to the unit of metal.	Specific heat.	
Iron,	.1111	.1100	Petit & Dulong.
Copper,	.0907	.0949	" "
Brass,	.0940	.1100	Dalton.
Silver,	.0532	.0557	Petit & Dulong.
Gold,	.0236	.0298	" "

It must be observed that the above statements of specific heats, taken from Petit and Dulong, are those of the mean effect from 0° to 100° centigrade. That of silver, for example, is .0557 within these limits, but if the mean specific heat found by them from 1° to 300° cent. be adopted it will come somewhat above the result of my experiments, that is .0611.

The method which has thus been adopted adds another to the means heretofore employed for determining the specific heat of many solid and gaseous substances, or at least of verifying the results of former methods. The three modes, just alluded to, are those of *mixture*, of *melting ice*, and of *cooling in air*, the last in particular seems liable to many objections on account of the different conducting and radiating power of the bodies, and the different natures of the surface which may be given to each, whereby the *time* of cooling, which is made the measure, will be exceedingly variable.

The calorimeter, of Lavoisier, is not regarded as correct in its indications, on account of the subsequent congelation of a portion of the ice, melted by the hot body, and the rise of temperature in water by *mixture,* involves the necessity of considering the increase of temperature, in the containing vessel, together with its separate specific heat, before any accurate result can be anticipated. The method of generating steam from an apparatus kept at a uniform temperature, and by means of bodies of known *superior temperatures,* is, I conceive, less liable to objection from any of these sources of fallacy. The only modifying cause, which deserves much attention, is the *barometric pressure* during the experiment, which involves also a consideration of the specific heat of steam under different pressures, but as this source of error may be obviated by performing experiments at uniform pressures, we need hardly take it into view, in estimating the general correctness of the mode now proposed of verifying the specific heats of bodies.

By knowing at what temperature we plunge a piece of metal under boiling water, the weight of the metal, and its mean capacity for heat, we may readily infer, from what is known of the quantity of latent heat in the unit by weight of steam, what weight of the liquid will be boiled off while the metal is reduced from a superior temperature down to 212°.

Thus let the *temperature* of the metal above 212° $=t$
Its *weight* $=w$
Its mean *capacity* between 212° and the known temperature $=c$
The latent *heat* of atmospheric steam $=l$
The weight of *steam* which the metal can produce $=s$

Then will $s=\frac{tcw}{l}$. Thus, suppose $t=2000°$, $c=.1111$, $w=16$oz. and $l=990°$, then we shall have $\frac{tcw}{l}=\frac{2000\times.1111\times16}{990}=3,571$ ounces.

From the above formula we derive immediately an expression for the *temperature* when all the other elements are known; for $ls=tcw$, whence $t=\frac{ls}{cw}$; so that when we would determine the actual temperature of a body above 212°, whose specific caloric has been carefully ascertained, we have only to *find what weight of vapor it will produce in coming down to the point of ebullition; multiply this by the latent heat in steam, and divide the product by the product of the weight of heated matter multiplied by its specific heat.* Upon the basis of this proposition I have constructed an instrument called the *steam pyrometer,* to be applied to the measurement of heat in incandescent metals, coals, and furnaces, to mark the melting point of metals, to verify the results presented by other instruments employed in similar operations, and to answer some other practical and scientific purposes. As the instrument would require a drawing in order to be fully understood, a description of it is postponed to a future occasion; several series of experiments on other points of the subject are likewise deferred.

Art. XV.—*Safety Apparatus for Steam Boats, being a combination of the Fusible Metal Disk with the common Safety Valve;* by A. D. Bache, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.

(Extracted from the Journal of the Franklin Institute for April, 1831.)

Among the causes which produce the explosions of steam boilers, no one stands more prominent, whether we have regard to the frequency of the explosions caused by it, or to their violence when they occur, than a defective supply of water within a boiler when in action. When the supply of water afforded to a boiler, is insufficient to compensate for the water which is converted into steam, the level of the fluid within is lowered; the boiler itself becomes heated, often intensely, and the steam partakes of this temperature without, from an insufficient supply of moisture to give the density corresponding to that temperature, having a corresponding elastic force. Of the existence of such a state of things within a boiler, the ordinary *safety valve* gives no indication, the tension of the steam within is not sufficient to overcome the weight with which the valve is loaded; it not only ceases to deserve the name of *safety* valve, but the opening of it, by hand, may be the very means of producing an explosion: for the escape of steam, thus permitted, relieves the water within the boiler from pressure; the fluid rises in foam; and being thrown into contact with the heated sides of the boiler, (or, as is supposed by some, being projected into the hot and unsaturated steam,) is flashed into steam, too considerable in quantity to find a vent through the valve, and of an elastic force sufficient to defy the controlling power of the materials used in the construction of the boiler. The raising of this valve is not necessary to the production of an explosion in the circumstances supposed, a supply of water suddenly introduced will produce the same dreadful effect. That such circumstances have frequently occurred, and have as frequently caused the results above described, is fully shown by the various authentic accounts of explosions on record.

The memoir of M. Arago, a translation of which is contained in the Journal of the Franklin Institute,* furnishes proofs of this fact; and the explosion of the boiler of the Chief Justice Marshall, during the last summer, has, I conceive, been fairly referred to the occurrence of similar circumstances.

The French Academy, when called upon, in 1823, to report to their government, the precautions to be used to prevent the explosions of steam boilers, satisfied of the insufficiency of the common valve to insure safety, required that in addition to two safety valves of the ordinary construction, one at the disposal of the engineer, the other under lock and key, there should be two plates of fusible metal covering apertures in the boiler; the one having its melting point at 18° F. above the temperature of the steam, which, according to the statement of the proprietor, made when his engine was established, was required to be used in the engine, the other at 18° above the fusing point of the first: the fusing point of each is thus, even in a high pressure engine, much below the temperature to which the boiler being heated there would be danger of explosion.† Now whether the steam be very elastic or not, so soon as it, or the boiler, arrives at the temperature requisite to fuse these plates, they melt, and the steam is discharged; this, too, below the limit of temperature at which such a discharge of steam would, according to the statement made in the former part of this article, be attended with danger.

These plates are made of alloys of bismuth, tin, and lead, in proportions varied according to the temperatures at which they are required to melt; by covering each with a piece of fine wire-gauze, it is prevented from swelling out by the effect of softening as it verges towards the fusing point.

Experience has shown that these plates can be relied on, confidently, to answer the ends proposed. In the stationary engine we

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* Vol. V. No. 6, and Vol. VI. No. 1, 1830.

† Iron at a dull red heat has a temperature of 947° F. while steam of eleven atmospheres corresponds according to the late determination of Arago and Dulong to a temperature of 367.34° F

should thus, by borrowing from our brethren abroad, be provided with a certain remedy against explosions caused by the circumstances we have endeavored to explain, and also against the bursting of the boiler from an accumulation of steam within, should any accidental derangement of the common safety valve prevent its action. This device would be of the greatest value if applicable to steam boat boilers, for, being entirely without the control of the engineer, caution would be produced by the fact that any attempt to raise the steam above the proper pressure, or any inattention to the supply of water within the boiler, would be immediately made known to the captain and passengers by the noisy efflux of steam through the aperture opened by the melting of this tell-tale plate. If the plate were placed within sight of the passengers, the only means of an improper kind, to which the engineer could resort, to prevent its fusion, (sometimes practised in the stationary engine in France, according to M. Arago,) viz. keeping it cool by the application of water to its surface, would be entirely cut off.

The reason why this plate has been considered inapplicable to steam boat boilers, in general, is obvious; when the plate melts, all the steam must escape from the boiler, and the apparatus must cool before it can be replaced by a similar plate; this sudden desertion of the prime mover of the engine might, in certain cases, put the lives of the passengers in almost as great jeopardy as an explosion; instances, in an exposed navigation, will readily occur on reflection, such as a boat on a lee-shore, &c. In all cases such a desertion would be attended with very great inconvenience.

The remedy for this, and one which simplicity and consequent ease of application seem to recommenced very particularly, will now be stated. If, as is hoped, this apparatus shall be found to remove every objection to the use of the fusible plate in the boilers of steam boats, it will insure the exemption of passengers from a portion at least of the dangers to which they are now so often exposed.

The method, which I would propose, is to combine the fusible plate, with the ordinary safety valve. Such a plate affixed to an opening of a proper size, in the boiler, as near as may be practicable to the highest line which is exposed to the direct action of the fire, is covered with a hollow cylinder, of a greater diameter than the aperture covered by the plate, the base of which presses upon the edges of the plate, while the top is arranged as the seat for a conical, or flat valve, of the ordinary kind; this valve will be habitually open, and when required to be used to prevent the escape of all the steam, will be pressed down, as is usual, by a weight acting by the intervention of a lever. This apparatus should be so placed upon the boiler as to be seen by the passengers, who are thus enabled to know that all is right, while the lever attached to the valve is in an elevated position, showing that the valve is raised from its seat; this lever is kept in its raised position, by a cross bar, supported on uprights, to which it is attached by a strong chain fastened by a padlock; the key of this lock being in the possession of the captain of the boat, the chain cannot be slipped, and of course the lever cannot be lowered, to close the valve, except through his agency. Suppose the steam or the boiler to become heated to the fusing point of the plate; it melts, steam issues through the small cylinder covering the plate, with a noise, which even at night would arouse the captain and passengers; if no danger will be incurred by loss of steam, and the consequent stoppage of the engine, such an escape should be allowed as a measure of precaution, though it is by no means one of necessity, since the limit of temperature producing fusion is much below that required for explosion. The alarm given, the steam gauge, should derangement of the safety valve have prevented its action, or, the usual practical observation upon the issuing steam, will show whether the fusion of the plate was caused by an accumulation of steam, or by the defective supply of water; this may be further tested by the guage cock; should it prove that the water is below the usual level, a supply can be introduced without danger. A second plate, arranged in a similar manner to the first, fusible at say 20° F. above this, should be also provided, that the same means of safety may remain in case of accident to the first plate. The vigilance of the engineer would almost be insured by the use of these plates, from a knowledge that his inattention could not escape detection and its consequences. Passengers would be guarded against the results of carelessness, should it exist, and captains, as well as the public, would have the means of knowing accurately the value of those employed in the responsible station of engineers. The want of patronage which would inevitably attend an ill regulated engine, would soon correct evils now so formidable.

By the annexed figures, the method of arranging the fusible plate and safety valve, is shown in detail.

Fig. 1.

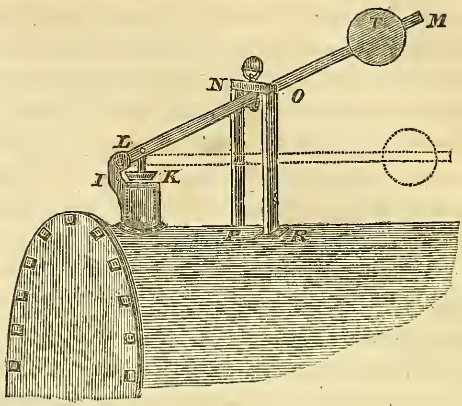
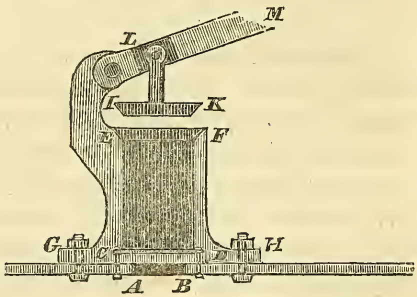


Fig. 1, represents an oblique view of part of a boiler with the safety apparatus attached. An unfavorable case, as to the space occupied by the apparatus, is taken, namely, that of a high pressure boiler required to work with steam of 150 lbs. bursting pressure, (ten atmospheres,) rendering it necessary to load the valve with rather more than 150 pounds.

Fig. 2, gives more in detail the method of arranging the fusible plate, &c. being a section of the apparatus. The area of the aperture closed by the plate is taken at 3 square inches, which is one half more than the area of the safety valve commonly used in a high pressure boiler of 3 feet in diameter by 10 feet in length. A, B, Fig. 2. is the aperture closed by the plate, C, D, of fusible metal, covered by a piece of wire gauze to prevent the plate from yielding as the temperature approaches its point of fusion. The plate is surrounded by a cylinder, E, F, G, H, of a greater diameter than the plate, terminated, above, by the valve seat E, F. Should the fusible plate, in giving vent to the steam, be thrown upwards, as an expression used by Arago in relation to it, gives reason to suppose, the valve should not be in the cylinder, E, F, G, H, but in one at right angles to it, so that the valve seat should not be vertically over the fusible plate. The valve, I, K, is represented of the usual form, though it may be questioned, whether this is the best which can be given: it is drawn in the position which it should habitually have, that is, so far raised from the seat as to give an opening for the escape of steam, equal in area to the valve.

Fig. 2.



To retain the valve in its position, the lever L, M, fig. 1, is fastened to a bar of iron, N, O, (supported by the uprights, N, P, and O, R, of the same material) by a chain, which is attached to N, O, at one extremity, and which passing round the lever, returns through an opening in N, O, to the top of the bar, where it is secured by a padlock. In the drawing the area of the valve, I, K, is 4½ square inches; this, at 150 lbs. to the square inch, requires a weight of 675 lbs. to press it down. The short arm of the lever is 1½ inch, the long arm 30 inches, the weight, T, is then about 33 lbs.

To raise the valve sufficiently above its seat, requires in the case figured, stanchions of 12.4 inches high. The whole apparatus thus occupies less than three feet in length, and eighteen inches in height. The dotted lines represent the position of the valve when, after the fusion of the plate, it may have been closed.

Art. XVI.—*Treatise on the Steam Engine; by* James Renwick, LL. D. Professor of Natural Experimental Philosophy and Chemistry, in Columbia College, New York. New York: G. & C. & H. Carvill: 1830. pp. 328.

The Steam Engine has become at the present day an object of intense interest. The magnitude and variety of its performances awaken the highest admiration, while its resistless energies, triumphing as they sometimes do over the ingenuity of man that controls all things else, inspire almost a superstitious awe and reverence. In the fabulous ages, men would have invested it with the attributes of divinity, and would have offered to it incense to propitiate its favor.

The Steam Engine, moreover, affords the most striking exemplification of the natural alliance which subsists between philosophy and the arts,—an alliance which, though it is so obvious to the present age, and so natural in itself that, as Professor Playfair remarks, what is a *principle* in science is a *rule* in art, was still scarcely dreamed of before it was pointed out by Lord Bacon. As this is the united and most noble production of both science and art, so no one is qualified to compose a treatise on it who is not a proficient in both. No other man can comprehend it in all its vast relations; no other can effectually explore the causes of the dangers that still environ it; none can with so much probability hope to find the means of obviating those dangers; none can judge so well of proposed improvements in its construction; none is so likely to discover new methods of improvement. Before we can control the powers of nature, we must learn their laws or modes of action; and our dominion over them can be commensurate only with a knowledge of their properties. By studying the properties of flame, and especially of that which results from the combustion of the mixed gases extricated in coal mines, Davy was led by a short and easy route to the discovery of the safety lamp; and it was by learning the properties of the electric fluid, that Franklin subjected to his control the lightning itself.

Professor Renwick, we are happy to say, possesses in an eminent degree the qualifications to which we have alluded. Well versed in both mechanical and chemical philosophy, he is qualified to expound the various scientific principles that are necessary to be understood, in order to a complete knowledge of the construction of the Engine, or of the nature of the dangers which attend it, while his situation at the fountain-head of steam navigation, and his extensive intercourse with manufacturers of steam engines, and the most successful builders of steam boats, afford him great facilities for becoming intimately acquainted with the practical part of his subject. Under these favorable impressions of the author, we took up the work before us with the expectation of being highly gratified and instructed; and we are happy to add, that the perusal has not at all disappointed us. We can therefore cordially recommend this Treatise, as a work which contains an able and succinct account of the Steam Engine in its various forms, presenting a perspicuous view of this great subject in its multiplied relations, as it regards its construction, the means of insuring its safety, its applications, and its history.

Under the head of "Mechanical and Physical Principles," with which the work commences, we are presented with a concise but luminous view of those principles of mechanics, and those laws of heat, which relate to the Steam Engine. This part of the work is well adapted to a numerous class of readers, embracing a large proportion of the practical men for whom the Treatise was designed, who have not had an opportunity to acquire this knowledge in the regular course of education; and to many who had once acquired the same information, it will serve as a useful review, and nothing will contribute more to a clear and intelligent acquaintance with the whole doctrine of the Steam Engine, and with all the discussions that arise respecting the sources of its dangers and their proper remedies, than a fresh and familiar knowledge of these elementary principles.

After principles have been studied in the abstract, we love to see them brought into near connexion with the arts which they illustrate, and we renew our acquaintance with them with increased pleasure, when we recognise them in their useful applications.

The article on Combustion, in the second chapter, is particularly worthy of attention; and we know not where to find, within the same compass, more useful information on this important subject, not merely in reference to the Steam Engine, but to the ordinary purposes of life.

We do not propose to follow our author through all parts of his work, but shall have chiefly in view those parts which are at present peculiarly interesting to the community, namely, *the means of securing safety* in the use of the Steam Engine.

The dangers of the Steam Engine are obviously of a twofold character,—such as result from defective construction of the machinery, and such as arise from the peculiar nature of the moving force. The work before us begins with the consideration of the former, particularly as it relates to the construction of *boilers.* We subjoin an extract on the *materials* of boilers.

Boilers are always of metal, and three different materials are used in their construction: wrought iron, cast iron, and copper. Wrought iron and copper are rolled for this purpose into plates and sheets, which, after being bent to the proper form, are united by bolts, driven through holes punched around their edges, and riveted. When cast iron is used for boilers, they may either be of a single piece, or it may be cast in separate portions, which are united by screw bolts and nuts, passing through holes left or drilled in flaunches. Of the two first, copper is most easily worked, but it is by far the most expensive material, and is therefore now used only in a few instances, where the others are, from the circumstances of the case, inadmissible. Copper is much less easily acted on by oxygen, than sheet iron; it acts less powerfully on the saline deposits, that occur when sea or other impure water is used; in addition, it is less liable, than either of the other materials, to split or crack on sudden changes of temperature. Sheet iron is more tenacious than copper, but is liable to rapid oxidation, and has frequently invisible joints arising from the manner in which it is manufactured. Still, however, when the water used is tolerably pure, it is the best material, if we take into view the strength and compararive cheapness.—*p.* 67.

Upon the subject of employing *tubes* instead of boilers, upon which so much was said a few years since, our author offers the following remarks.

As the quantity of steam generated, depends wholly upon the surface of the boiler that is exposed to heat, and as the saving of weight is, in many cases, advantageous, it has been proposed to use a combination of tubes for boilers, which will expose a much greater surface, in comparison with their internal capacity, than larger cylinders; for it is a mathematical law, that while the surfaces of cylinders of equal length increase as the diameters simply, their internal capacity increases with the squares of that dimension. A saving may also be made in the material of which the tubes are constructed, for the strength of a metallic tube to resist an effort to burst it, increases in the inverse ratio of its diameter. It has also been proposed to immerse such tubes wholly in the flame, and inject into them, from time to time, a certain quantity of water, to be converted almost instantly and wholly into steam. Such were the original boilers of Babcock. The first of these plans has a speedy limit in practice, and the last is wholly inadmissible, as will appear from the following considerations.

1. The presence of a conducting body in the midst of the flame, will cool the gas of which it is composed, diminish the intensity of the combustion, and the draught of the chimney.

2. When tubes are actually heated to the proper degree, and no longer act to cool the flame, the flues must be made short enough to permit the air to enter the chimney as soon as it is cooled down to the temperature of the tubes, otherwise, instead of heating them farther, it will tend to cool them.—*pp. 72 and 73.*

Another very serious objection to the use of tubes in the place of boilers (the tubes being immersed in the flame,) is found in certain anomalous effects produced upon steam when brought into contact with a highly heated surface, effects to which we shall advert more particularly by and by. It is an additional objection to tubes, that the deposits of solid matter, which fall from almost all water when evaporated, and which are greater in proportion as the water is more impure, become harder and more compact than when the boiler is kept full of water. They also adhere more forcibly to the metal, and are more liable to corrode it. The author, however, concedes that this method has the advantage of being free from all risk of explosion, and that there are of course cases where this advantage may be worth obtaining, even at the sacrifice of a considerable quantity of heat.

But we cannot fairly estimate the degree of strength necessary to be maintained in the boiler, and the other parts of the apparatus, or understand the various precautions necessary in order to insure safety in the use of the steam engine, without understanding very fully the nature of the moving force. Let us therefore review the LEADING FACTS RESPECTING STEAM, especially such as relate to the subject before us.

1. It will be recollected, that the great and peculiar property, on which the mechanical agencies of steam depend, is its power of exerting at one moment a high degree of elastic force, and losing it instantaneously the next moment. This force, acting on the bottom of the piston, which moves in the main Cylinder, raises it, and fills the space below it with steam. The steam is suddenly condensed, and hence no obstacle is opposed to the descent of the piston, but it is readily forced down again by steam acting from above. This alternate motion of the piston, the rod of which is connected with the working beam, is all that is required in order to communicate motion to all parts of the engine.

2. The elastic force of steam depends on the temperature at which it is formed; and the temperature necessary to its production depends upon the pressure incumbent upon the water during its formation.

Water is capable of forming vapor at all temperatures whatsoever. Its tendency to rise is, however, impeded by pressure, and thus it does not boil in an open vessel, when the rising of steam is impeded by the resistance of the atmosphere, until it reaches the temperature of 212°. But with each diminution of pressure, the boiling temperature becomes lower, until, in the vacuum of an air pump, it boils at 90°, [70°?]. Hence, so soon as a portion of the steam is condensed, fresh vapor will be rapidly formed, at a lower temperature, and, although the expansive force of this diminishes in a geometric ratio, yet it is still capable of opposing a resistance to the motion of the piston. This resistance is such that it has been found by experience, that the vapor of water at 212°, whose expansive force is equivalent to a pressure of fifteen pounds on every square inch, had never acted on the piston with a mean force of more than ten pounds, until means were applied to remove or obviate this resistance.—*p.* 117.

The reason why water boils at the temperature of 212° is that, at that temperature, the vapor acquires just elasticity sufficient to overcome the atmospheric pressure. Hence, it is said that steam produced at the temperature of boiling water, has a force equal to the pressure of the atmosphere. It has, in fact, a force a little greater than that, since it overcomes that pressure. If we introduce a few grains of water into a vessel, as a flask, and place the vessel over the fire, the water will soon be converted into steam, which will expel the air of the vessel and fill its whole capacity. If we now close the orifice of the vessel and continue the heat, the steam will expand in the same manner as air would do under similar circumstances, which is at a comparatively moderate rate, so that it might be heated red hot without exerting any very violent force. If, however, the vessel is partly filled with water, and the heat is continued as before, then the elastic force is rapidly augmented, and becomes at length so great as to burst almost any vessel that can be provided; for every portion of new vapor that is raised from the surface of the water, adds to the density of that which was before in the vessel, and proportionally increases its elasticity.

In experiments made by Perkins, steam was heated to a temperature at which, if of a corresponding density, it ought to have exerted a force of fifty six thousand pounds per square inch, but which did not exert a pressure of more than one hundred and fifty pounds. The reason is obvious, for it was enclosed in a separate vessel, and its quantity remaining constant, it did not increase in density. Had, however, a small additional quantity of water heated under pressure to a high temperature, been injected, it might be inferred, that the steam would have acquired the density necessary to enable it to exert the force corresponding to its temperature. Perkins also established the truth of this inference by actual experiment. Water was heated in one of his generators, the safety valve of which was loaded with a weight of sixty atmospheres, to a temperature of 900°; a receiver was prepared, void of both air and steam, and heated to upwards of 1800°; a small quantity of water was then made to pass from the generator to the receiver; this was instantly converted into steam, whose heat was sufficient to inflame the hemp that coated the tube, at the distance of ten feet from the generator. Its temperature was therefore estimated at not less than 1400°. In spite of this high temperature at which the steam was formed, its pressure did not exceed five atmospheres. But by injecting more water, although the temperature was lessened, the elastic force was gradually increased to one hundred atmospheres.—*p.* 95.

3. The space occupied by a given weight of vapor, depends on the degree of pressure under which it is formed. Water converted

into vapor at the temperature of 212° expands nearly 1700 times; but at the temperature of 419°, it expands but 37 times. Dr. Thomson, in his recent work on Heat and Electricity, adds, "that it is probable that at a temperature not much higher than 500°, the steam of water would not much exceed double the bulk of the water from which it was generated. The expansive force of such steam would be truly formidable. It would, when it issued into the atmosphere, suddenly expand almost 650 times. We do not know at what temperature water would become vapor without any increase of volume. But it would then support a column of mercury 3243 feet in height, and exert a force of 19.459 lbs. upon every square inch of the vessel containing it."*

4. The absolute quantity of heat is always the same in the same weight of steam, whatever may be the temperature of that steam. When the vapor is formed at a low temperature, nearly all the heat that enters it is in the latent state; but as we heat it to a higher degree, its proportion of sensible heat is constantly augmented, and of latent heat diminished in the same ratio, so that the sum of the two is the same constant quantity.†

"If (says Dr. Thomson) we could apply such a pressure to water, that we could heat it till its sensible heat arose to 1212°, it is obvious that it would be converted into steam having the specific gravity, and consequently the volume of the original water. The latent heat of

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* Outline of the Sciences of Heat and Electricity, p. 222.

† As some of our readers may not be familiar with the precise signification of the terms *latent heat*, *specific heat*, and *capacity for heat*, which occur in connexion with this subject, we will briefly explain them. *Latent heat* is that which enters into a body while changing its state from solid to liquid or from liquid to æriform, which portion of heat is not sensible to the thermometer, but disappears or becomes latent as water does when added to quick lime. Thus, when water is converted into steam in the common process of ebullition, a quantity of heat enters into the water to convert it into steam, which if applied to water would be sufficient to raise it nearly 1000 degrees, but which does not raise the temperature of either the water or the steam in the least degree. Hence the latent heat of steam is said to be 1000. *Specific heat* is the absolute quantity of heat which a body contains compared with another body of the same weight and temperature, taken as the standard unit. Thus, steam is said to have a specific heat of 1.7778, because if we take equal weights of air and steam at the same temperature, it can be proved that the actual quantities of heat which these two bodies contain are in that ratio to each other. The term *capacity for heat* is sometimes employed as synonymous with specific heat: where any distinction is intended, it is this, that the one denotes the ratio of the actual quantities of heat contained, while the other denotes the ratio of the powers of containing these respective quantities, which ratios are evidently the same in both cases.

such steam would be 0°; but its elasticity would be prodigious. The instant that the pressure upon it was removed, it would expand, and its latent heat would increase at the expense of its sensible heat. It is obvious from this that the existence of latent heat in steam is owing to its expansion, and that the moment we reduce it to the bulk of the water from which it was generated, all the latent heat becomes sensible."*

5. Steam has certain remarkable and anomalous properties when brought into contact with a highly heated surface.

If a polished spoon of iron be taken and heated to a white heat, and a drop of water be let fall upon it, the drop divides at first into several smaller ones, which, however, speedily unite. This if it be closely observed, will be seen to have acquired a rotary motion; it continually decreases in bulk and finally explodes. A second and a third drop exhibit the same phenomena, but the continuance of the drop upon the metal becomes less and less as the latter cools. While the first drop remained forty seconds, the third remained only six seconds, and the sixth evaporated instantly.

Perkins has recently observed similar phenomena in the generator of his engine. This vessel being heated red hot while empty, water was admitted. The elastic force of the vapor, was at first but small, and increased rapidly as the temperature of the generator was diminished.—*pp.* 73, 74.

Having now reviewed the leading properties of steam, we are prepared to consider the methods of insuring safety in the use of this powerful agent.

Those tremendous explosions which occasionally afford such melancholy proofs of the dangers with which the steam engine is encompassed, arise from the energy inherent in the moving force itself—from a deficiency in the supply of water to the boiler—from the weakness of the material of which the boiler is constructed—from its becoming incrusted with saline and earthy matter—and from what is called a collapsing of the boiler.

More or less danger is always involved in the employment of powers of great energy. The horse will sometimes grow furious and throw his rider; winds become hurricanes and wreck the mariner; water wheels seize upon the manufacturer and tear him in pieces; powder-mills explode in spite of all the vigilance of man. Wherev-

* Outlines of the Sciences of Heat and Electricity, p. 231.

er safety depends on human vigilance, it will sometimes be jeopardized; for that vigilance will sometimes slumber.

But notwithstanding the dangers inseparable from so powerful an agent as steam, yet in fact but few of the explosions of the steam engine which have ever taken place are attributable simply to the energies of the moving force.

In all cases, where fatal accidents have occurred, the explosion appears to have been due to other causes than the mere expansive force of the steam that would be formed when the boiler is in proper order, and supplied with water.—*p.* 97.

This, however, it must be acknowledged, is only saying, that nothing need be apprehended from the energies of the moving force employed, if we always guard it sufficiently; while the improbability of employing such a guard at all times is such, as to render the employment of powerful agents always more or less dangerous.

It would seem at first view a very easy matter to provide against any danger from the active energies of steam, by the means of *safety valves*. These, however, sometimes, either by accident or design, become too heavily loaded; they are also liable to lose their sensibility by becoming rusty, and in various other ways; and such vast quantities of steam are sometimes suddenly generated, that the safety valves are inadequate to afford any relief. Our author strongly recommends that every boiler should be furnished with two safety valves, one of which should not be under the control of the fireman.

It would also appear to be within our power to provide against hazard from the expansive force of steam by *proving* the boilers; that is, by previously subjecting them to a pressure much greater than that under which they are intended to work.

It has been proposed to apply a pressure five or six times as great as the boiler is intended to bear. Nor is this too great a precaution, for the water proof is performed when cold, and the metal is then more tenacious than when heated, and the proportion of six to one, at least, is necessary before this difference is obviated. If a boiler be not subjected to such proof, it may be possible that when heated, its limit of rupture may be reached before the safety valve opens. The water proof having been performed, the boiler should next be subjected to a similar trial by steam, say of twice the force that is usually to be generated in the boiler without causing its safety valves to act. In France, it is required by law, that all high pressure boilers be subjected to a proof five times as great as the boiler is intended to bear when in service.—*p.* 85.

The corrosion effected by the chemical agents that are constantly acting upon the material of the boiler, and the changes of strength produced by sudden changes of temperature, render safety unattainable by any such single proof of strength in the boiler; nor ought it to be relied on, except for intervals of time of moderate duration. "A safety valve," says M. Arago, "however well constructed, can never warrant the engineer in neglecting to prove his boiler from time to time, nor can it warrant him in not endeavoring to prevent by all the means in his power abrupt changes in the elasticity of the steam, and in not preventing the boiler from, at any time, being too strongly heated.

A deficiency in the supply of water to the boiler, is one of the most common causes of the explosion of steam engines. By this means the upper parts of the boiler, when the flame plays on them, become heated even to redness. This greatly impairs the cohesion of the metal, and proportionally weakens the boiler. The metallic surface also, under such circumstances, rapidly corrodes, and is thus weakened still farther. Meanwhile the steam, in contact with the upper surface of the boiler, is becoming intensely hot, without acquiring a proportionate density and elasticity. The moment, therefore, the water below is, by any means, brought into contact with this heated surface, and mixed with the hot steam, the latter instantly acquires great density and a tremendous force, against which the safety valves are incompetent to provide, and which the boiler now is unable to resist, and a violent explosion is the inevitable consequence.

It is a remarkable fact, and one unaccounted for, until it was explained by Mr. Perkins after his investigations into the properties of steam at very high temperatures, that *boilers frequently burst at the very moment of opening the safety valve.* The water within the boiler being low, and the steam which presses upon its surface very much heated, but of little elastic force, suppose the safety valve to be opened: a copious discharge of steam takes place; the water relieved from the pressure upon its surface, rises up in foam, the action being similar to that which takes place in a champaigne bottle on drawing the cork; the water thus thrown in small drops into the midst of an intensely heated vapor, flashes into highly elastic steam, and the safety valve not affording a sufficient vent for the discharge of the steam, the boiler is rent."*

* Arago on the Explosion of Boilers.

In order to obviate the dangers which result from a deficiency of water in the boiler, and a consequent heating of the upper surface, and of the flues when these are employed, several different methods are used. Guage cocks are attached to the boiler, which the engineer turns at short intervals, for the purpose of ascertaining the level of the water; and a thermometer ought to be connected with the boiler in such a manner that its indications may be seen from without. A still more effectual way of guarding against the consequences of an accumulation of heat in the upper part of the boiler, is by means of plates of fusible metal. It is well known that an alloy composed of lead, tin, and bismuth, has the property of melting at a very low temperature, sometimes even, when the best proportions are observed, at a temperature below that of boiling water. By varying the proportions of the ingredients, various degrees of fusibility may be attained. A plate of this alloy connected with the boiler of a steam engine, and having such a degree of fusibility as to melt at a temperature so low as to let off the steam before it could acquire a dangerous degree of heat, promises to afford the most effectual security hitherto devised against the dangers which arise from overheating the boiler, or any part of it. Upon this subject M. Arago has the following remarks. "As soon as it was found that the common safety valves sometimes got out of order, and did not present a certainty of security, it was proposed to replace them by an entirely different contrivance, the action of which should never be uncertain. This was the fusible metal valve. To understand rightly the nature of these valves, we should know that it is possible that steam should have a very high temperature, and but little elasticity, but not possible that a great degree of elasticity should not be accompanied by a high temperature. Experiments have determined the lowest temperatures necessary for steam to acquire a tension of one, two, three, ten, &c. atmospheres. By using these results, we can know what temperature the steam must not surpass, after we have fixed upon the pressure. If then we cover an opening in the boiler with a plate made of an alloy of lead, tin, and bismuth, in proportions such that the alloy will melt at the limit of temperature fixed upon before hand, this temperature can never be exceeded, for on reaching it, the plate melts and gives vent to the steam. *In France, a royal ordinance requires that every boiler shall be provided with two fusible plates of unequal sizes.* The fusing point of the smaller is 10°, (18° Fah.) above the temperature of steam having an elasticity equal to that which the steam to be used in the engine should have. The second plate fuses at 10°, (18° Fah.) above the first.

"Although many cases may be cited in which fusible plates have probably prevented explosions, they are employed unwillingly by most, preference being given to the common valves, with which, in addition to the plates, the boilers must be provided. Let us then examine the objections to these plates. It was said at first that since these plates were affected by temperature, and not by pressure, they might melt when the steam within was very hot, but not elastic in proportion, but this can happen only when the vapor is not saturated with moisture: that is, only when there is not a sufficient supply of water within the boiler; then a portion of the boiler must become heated, perhaps even to redness, and then there is eminent danger of explosion. This first objection, therefore, seems to be refuted. The plate does not approach the point of fusion, without being softened; it is therefore feared that it may give way under a tension much less than that which would produce its fusion. At the outset, this did actually take place, but the difficulty has been obviated by covering the plate with a wire gauze, of small meshes, before it is fixed by bolts to the aperture which it is to close. Even now parts of the plate yield partially, swelling out in different places as the fusing point approaches; but experience has shown that it is only very near to this point that the metal yields entirely, opening a free passage to the steam. When the fusible plate has been melted, all the steam escapes through the opening which it closed. It may take some time to replace it, to fill anew the boiler, and to heat the water, and during this time the engine stands still. In a steam boat, in certain cases, this sudden absence of the moving power, might occasion serious accidents. This is a real and a great difficulty, and perhaps is the reason why our neighbors have not adopted the fusible metal valve, but give preference to the ordinary safety valve. These it is true, never suffer all the steam to escape. If they open, it is only when the elasticity of the steam within has passed a certain limit; as soon as this elasticity has returned within the limits fixed by the engineer before hand, they fall, closing the aperture; and thus the moving power can never fail entirely.

"The advocates of the fusible metal plates, considered as one of the highest advantages of these valves, the physical impossibility of changing their limit of action, thus placing them beyond the reach of imprudent workmen. It is true that with these plates, all overcharge, in the literal meaning of the word, would be useless; but when the firemen wish to urge their fires more than usual, they understand how to prevent the fusion of the plate, by directing a constant stream of cold water upon it, so that in this point of view, perhaps we have gained nothing."*

We have extracted this passage at length from the essay of M. Arago, because it appears to us that the subject of fusible metal valves has not commanded among our countrymen the attention it deserves. We do not learn indeed, that a single trial has yet been made of them. And surely, the repeated and melancholy instances of steam boat explosions, that have occurred among us during the last two or three years, ought to awaken our attention to any devices for securing safety, especially when recommended by authority so respectable as that of M. Arago. There is some reason to fear a growing apathy in the public mind on the subject of steam boat accidents, from the very frequency of their occurrence. Those who have often escaped, while others have fallen, fancy themselves, like veteran soldiers, invulnerable.

Professor Renwick recapitulates the chief precautions to be employed in order to insure safety, in the following paragraphs. Several of them we have already mentioned incidentally, but the importance of the subject induces us to extract this passage entire.

1. Cylindrical boilers, without any return flue, either without or within, are safer than any others.

2 Internal flues should be avoided whenever it is possible, and especially the chimney, or vertical flue, should never be permitted to pass through the boiler.

3. Every boiler should be furnished, in addition to the safety valve, with one not under the control of the fireman.

4. All boilers should be furnished with guage cocks, or other apparatus, to show the level of the water, and these should be so placed in steam boats, that no error in their indication can take place when the vessel heels or rolls.

5. Plates of fusible metal should be provided.

6. A thermometer should be introduced into the boiler, whose indications may be seen from without.

7. Self-acting feeding apparatus should be adapted to the boiler, by which water will enter, and keep the fluid within at a constant level, and this should depend upon the waste of water, and not on the action of the engine. It unluckily happens that no such apparatus

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* Arago, on the Explosion of Boilers, in Franklin Journal, Vol. V. p. 410.

has yet been contrived for high pressure engines, nor indeed for any where the tension of the steam exceeds $1\frac{1}{4}$ atmospheres. Neither are they always applied even to low pressure engines.

8. The chimney should be provided with a damper, by which the draught of the flues may be suddenly checked, and doors should, if possible, be placed upon the ash pit. A damper that would close as soon as the engine ceased to move, would be of great service in lessening the liability to explosion, and this does not appear to be difficult of attainment.

9. The proof of the boiler should be conducted with the greatest care, first with water, at a pressure five or six times as great as the boiler is intended to carry, and afterwards with steam of twice the proposed tension. The water proof should be repeated from time to time, and every part carefully examined to ascertain that all the safety apparatus is in working order.—pp. 101—2.

The following paragraph presents us with a fearful view, of the negligence which prevails in our country in respect to these precautions. An intelligent gentleman, intimately acquainted with the state of steam boat navigation in this country, has intimated to us, that the negligence is not so great as is here represented. We hope it is not; but the terrible disasters that are multiplying upon us, give us too much reason to fear that the account is substantially true. It is as follows.

Few or none of these precautions are usual in our American steam boats: the boilers, even if cylinders, have both internal flues and furnaces, and the vertical chimney frequently rises in the boiler; there is never more than one safety valve; plates of fusible metal are unknown; the feeding apparatus is merely a forcing pump, which is turned on or thrown off at the pleasure of the engineer, and which does not act at all at the time the engine is not in motion; but a very few steam boats have dampers upon their flues; and the proof is wholly a matter between the maker and proprietor, and for its proper performance the public have no guarantee. Thus, of all the precautions that have been proposed in order to insure indemnity from explosion, but two are in use among our steam boats, namely, the safety valve and guage cocks; the former being still subject to the caprice of the persons employed, and the latter having an uncertainty in their indications, both when the boat inclines to either side, and when they contain, as they most frequently will do, water of condensation. Need we wonder that explosions have become frequent, and that they have produced the most fatal consequences?

The means which are used are not certain to insure safety, even when the care of the officers of the vessel, and of the persons employed about the engine, is unremitting, and directed by the utmost intelligence; and hence dangerous accidents occur without giving rise to blame, and thus diminish a proper feeling of responsibility.—*pp.* 102, 103.

A great proportion of the fatal accidents which have occurred in steam boats, have arisen from a *collapsing of the boilers*; that is, in consequence of the sudden formation of a vacuum in the boiler, by which means the sides of the boiler have been crushed together by external pressure, and the hot water and steam forced out with great violence. It seems a very easy matter to provide against this source of danger, by attaching to the upper parts of the boiler an air valve opening inwards. Whenever the tension of the steam becomes less than the pressure of the atmosphere, the valve will open and restore the equilibrium.

Finally, notwithstanding the dangers inherent in the employment of a force of such tremendous energy as steam, yet it is easy to overrate the actual dangers. When steam boats explode, the catastrophe usually involves so many sufferers, and becomes so widely known and discussed, that the dangers are greatly exaggerated in comparison with those more silent and unobtrusive but not less real dangers, that attend all the other modes of travelling by sea and land. One flies from the city of the plague and meets a watery grave; another shuns the seas and finds the pestilence on land.

Frustra cruento Marte carebimus,
Fractisque rauci fluctibus Adriæ.

We are happy to be able to conclude this article by presenting to our readers, the following facts and observations, obligingly communicated to us by a valued correspondent.*

List of Steam Boat Explosions which have occurred in the U. States.

HIGH PRESSURE.

	Names.	Place of explosion.		
	Constitution,	Ohio,	13 killed.	
	Gen. Robinson,	Mississippi,	9 "	
	Yankee,	"	4 "	
	Heriot,	"	1 "	
	Ætna,	N. Y. Bay	13 "	
1828,	Grampus,	Mississippi,	Unknown.	
	Barnet,	L. I. Sound,	1 killed.	
1830,	Helen McGregor,	Mississippi,	33 "	14 wounded.
			74	14

* Mr. William C. Redfield, of New York.

LOW PRESSURE.

Previous to	Names.	Kind of boiler.	Place of explosion.	Killed.	Wounded.
1825	Enterprise,	(copper)	Charleston, S. C.	9	4
"	Paragon,	"	Hudson River,	1	1
"	Alabama,		Mississippi,	4	
"	Feliciana,		"	2	
"	Arkansaw,		Red River,	4	
"	Fidelity,	(copper)	N. York harbor,	2	
"	Patent,	"	"	5	2
"	Atlanta,	"	"	2	
"	Bellona,	"	"	2	
"	Maid of Orleans,	"	Savannah River,	6	
"	Rariton,	(unknown)	Rariton River,	1	
"	Eagle,		Chesapeak,	2	several.
"	Bristol,		Delaware River,		1
"	Powhatan,	(copper)	Norfolk,	2	
1824,	Jersey,	"	Jersey City,	2	
1825,	Tesch,		Mississippi,	several.	
"	Constitution,		Hudson River,	3	
"	Legislator,		N. York harbor,	5	2
1826,	Hudson,		East River,		1
"	Franklin,		Hudson River,	1	
"	Ramapo, in Jan.		New Orleans,	5	2
"	Do. March,		"	1	1
1827,	Oliver Ellsworth,		L. I. Sound,	3	
1830,	Carolina,		N. York harbor,	1	
"	Ch. J. Marshall,	(copper)	Hudson River,	11	2
"	United States,		East River,	9	
1831,	General Jackson,		Hudson " (supposed)	12	13
				95	29

CHARACTER OF ENGINES NOT SPECIFIED.

	Names.		Place of explosion.	Killed.	Wounded.
	Cotton Plant,		Mobile,	unknown.	unknown.
	Washington,		Ohio River,	"	"
1826,	Macon,		South Carolina,	4	
1827,	Hornet,		Alabama,	2	2
1826,	Susquehannah,		Susquehannah,	2	
1827,	Union,		Ohio River,	4	7
1830,	Wm. Peacock,	(st'm pipe)	Buffaloe,	15	

	Names.	Place of explosion.	Killed.	Wounded.
"	New Caledonia,	Mississippi,	11	11
"	Kenhawa,	Ohio River,	8	4
"	Car of Commerce,	"	28	29
"	Atlas,	Mississippi,	1	
"	Andrew Jackson,	Savannah R.	2	
1831,	Tri-Color,	Ohio River,	8	8
			85	61

Total, killed, 254; Wounded, 104.

"In some of the principal accidents comprised in the foregoing list, the number of killed includes all who failed to recover from their wounds. In other cases the numbers are as given in the newspapers of the day, and some of the wounded should perhaps be added. In some few instances no list has been obtained, and possibly in some, no loss has occurred. The accounts of some of the minor accidents may have been lost sight of or overlooked in my files. *In making an approximate estimate of the whole number of lives which have been lost in the United States by these accidents, I should fix it at three hundred.*

"Although this is a melancholy detail of casualties, yet it seems less formidable when placed in comparison with the ordinary causes of mortality, and especially when contrasted with the insatiate demands of intemperance and ambition. It is believed that it will appear small when compared with the whole amount of injury and loss, which has been sustained by travelling in stages and other kinds of carriages. More lives have probably been lost from sloops and packets on the waters of this State, since the introduction of steam boats, than by all the accidents in the latter, though the number of passengers exposed has been much smaller. In one case that occurred within a few years, thirty four persons were drowned on board a sloop in the North river, and many instances involving the loss of a smaller number of lives, and one loss has occurred on the Sound of twelve or fourteen individuals.

"It will be seen by reference to the foregoing list, that of twenty five lives that have been lost on board of New York steam boats, previous to the case of the Chief Justice Marshall, and excluding the case of the Etna, only *one passenger** is included in the number.

* *Mr. Lockwood,* on board the Oliver Ellsworth.

Even in the more fatal cases which are here excluded, and in all accidents of this nature, the chief loss is sustained by the crew and officers attached to the boats, who, by the nature of their employments, are compelled to encounter by far the greatest portion of the hazard.

" An earnest and persevering attention to the safety of steam boilers, and strict personal inquiry into the accidents which have occurred, enables me to state fearlessly, though in opposition to received opinions, that since the year 1824, no accident in this region has been justly chargeable, either to want of water in the boiler, or to culpable negligence or incompetency; but every one has arisen from *the defective form and structure of the boilers* which have failed. Some *of the most* careful and meritorious of the engineers and attendants have suffered at their posts, and have sunk into their graves under imputations as unmerited as they were gratuitous and cruel. Nor can a resort to legislative enactments either remedy the evil, or afford any additional security; but the matter must be left to the intelligence of the age, and to the operation of motives which are more powerfully felt by the owners and managers of steam boats, than any which legislative authority can impose.

"Notwithstanding the multiplication of steam boat accidents during the last and present seasons, still the hazard, or the average loss of life is constantly diminishing, and will probably diminish in a still greater ratio, as soon as the large, ill-constructed, and unsafe boilers, which were in vogue a few years since under the soothing cognomen of *low pressure* boilers, shall have been finally discarded, in which result considerable progress has already been made.

" The amount of steam boat business in this country has been increased immensely since 1824, and perhaps exceeds the average of the preceding period by fifty or one hundred fold. In 1824, but one steam boat ran in the waters of Connecticut, and but two from New York, eastward, and with a small number of passengers compared with what they now carry. Now we have sixteen or twenty in full activity in that direction. One boat on the Hudson, built in 1825, has carried near two hundred thousand passengers, and we have now sixteen or eighteen boats plying on the Hudson, while southward from this city the change has been equally great. So late as the commencement of the year 1817, the whole number of steam boats which had been built on the western waters, was ten, and in that year the feat of performing a passage from New Orleans to the falls of the Ohio, in twenty five days, was celebrated by public rejoicings. A late article on the subject which accords in its facts with other statements which I have, contains the following statements.

"'The whole number of steam boats which have been built upon the western waters is about three hundred seventy five. Some of them are of five hundred tons burden, and from that down to one hundred, and their average not over two hundred tons. The number now in commission is something over two hundred. Their annual expense for fuel is estimated at one million one hundred and eighty one thousand dollars, and the other expenses at one million three hundred thousand, making an aggregate of nearly two million five hundred thousand dollars.

"The value of steam navigation to the United States, and particularly to the great valley of Mississippi, is incalculable; it defies the power of calculation. We doubt whether the citizens of the United States, who duly appreciate its importance, would be willing to part with it for the amount of the debt of Great Britain of eight hundred millions of pounds sterling. But for the introduction of steam navigation into the United States, and its bringing, as it were into juxta position, the extreme regions of her widely extended borders by "conquering time and space," and but for its happy influence in promoting international commerce, and social intercourse by the ties of interests it creates, in a thousand different ways, the Atlantic and Western states would soon have become alienated from each other, and a separation would have been the consequence.'"

Art. XVII.—*On a Reciprocating motion produced by Magnetic Attraction and Repulsion; by* Prof. Joseph Henry.

TO THE EDITOR.

Sir,—I have lately succeeded in producing motion in a little machine by a power, which, I believe, has never before been applied in mechanics—by magnetic attraction and repulsion.

Not much importance, however, is attached to the invention, since the atricle, in its present state, can only be considered a philosophical toy; although, in the progress of discovery and invention, it is not impossible that the same principle, or some modification of it on a more extended scale, may hereafter be applied to some useful purpose. But without reference to its practical utility, and only viewed as a new effect produced by one of the most mysterious agents of nature, you will not, perhaps, think the following account of it unworthy of a place in the Journal of Science.

It is well known that an attractive or repulsive force is exerted between two magnets, according as poles of different names, or poles of the same name, are presented to each other.

In order to understand how this principle can be applied to produce a reciprocating motion, let us suppose a bar magnet to be supported horizontally on an axis passing through the center of gravity, in precisely the same manner as a dipping needle is poised; and suppose two other magnets to be placed perpendicularly, one under each pole of the horizontal magnet, and a little below it, with their north poles uppermost; then it is evident that the south pole of the horizontal magnet will be attracted by the north pole of one of the perpendicular magnets, and its north pole repelled by the north pole of the other: in this state it will remain at rest, but if, by any means, we reverse the polarity of the horizontal magnet, its position will be changed and the extremity, which was before attracted, will now be repelled; if the polarity be again reversed, the position will again be changed, and so on indefinitely: to produce, therefore, a continued vibration, it is only necessary to introduce, into this arrangement, some means by which the polarity of the horizontal magnet can be instantaneously changed, and that too by a cause which shall be put in operation by the motion of the magnet itself; how this can be effected, will not be difficult to conceive, when I mention that, instead of a permanent steel magnet, in the moveable part of the apparatus, a soft iron galvanic magnet is used.*

The change of polarity is produced simply by soldering to the extremities of the wires which surround the galvanic magnet, two small galvanic batteries in such a manner that the vibrations of the magnet itself may immerse these alternately into vessels of diluted acid; care being taken that the batteries are so attached that the current of galvanism from each shall pass around the magnet in an opposite direction.

Instead of soldering the batteries to the ends of the wires, and thus causing them at each vibration to be lifted from the acid by the power of the machine; they may be permanently fixed in the vessels,

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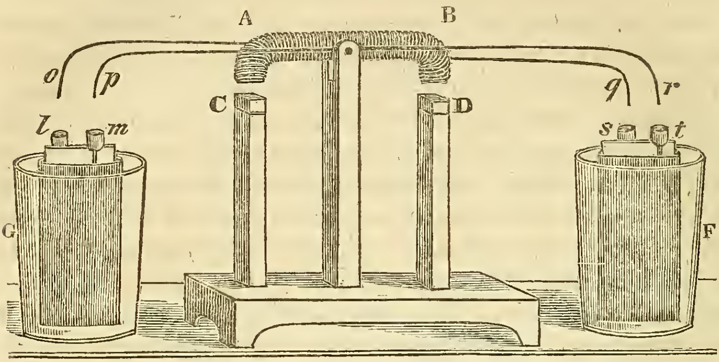
* For a method of constructing the galvanic magnet on an improved plan, see my paper in Vol. XIX, p. 329 of this Journal.

and the galvanic communication formed by the amalgamated ends of the wires dipping into cups of mercury.



The whole will be more readily understood by a reference to the annexed drawing; A B is the horizontal magnet, about seven inches long, and moveable on an axis at the center: its two extremities when placed in a horizontal line, are about one inch from the north poles of the upright magnets C and D. G and F are two large tumblers containing diluted acid, in each of which is immersed a plate of zinc surrounded with copper. *l*, *m*, *s*, *t*, are four brass thimbles soldered to the zinc and copper of the batteries and filled with mercury.

The galvanic magnet AB is wound with three strands of copper bell wire, each about twenty five feet long; the similar ends of these are twisted together so as to form two stiff wires, which project beyond the extremity B, and dip into the thimbles *s*, *t*.

To the wires *q*, *r*, two other wires are soldered so as to project in an opposite direction, and dip into the thimbles *l*, *m*. The wires of the galvanic magnet have thus, as it were, four projecting ends; and by inspecting the figure it will be seen that the extremity *m*, which dips into the cup attached to the copper of the battery in G corresponds to the extremity *r* connecting with the zinc F.

When the batteries are in action, if the end B is depressed until *q*, *r* dips into the cups *s*, *t*, AB instantly becomes a powerful magnet, having its north pole at B; this of course is repelled by the north pole D, while at the same time it is attracted by C, the position is consequently changed, and *o*, *p* comes in contact with the mercury in *l*, *m*; as soon as the communication is formed, the poles are reversed, and the position again changed. If the tumblers be filled with strong diluted acid, the motion is at first very rapid and powerful, but it soon almost entirely ceases. By partially filling the tumblers with weak acid, and occasionally adding a small quantity of fresh acid, a uniform motion, at the rate of seventy five vibrations in a minute, has been kept up for more than an hour: with a large battery and very weak acid, the motion might be continued for an indefinite length of time.

The motion, here described, is entirely distinct from that produced by the electro-magnetic combination of wires and magnets; it results directly from the mechanical action of ordinary magnetism: galvanism being only introduced for the purpose of changing the poles.

My friend, Prof. Green, of Philadelphia, to whom I first exhibited this machine in motion, recommended the substitution of galvanic magnets for the two perpendicular steel ones. If an article of this kind was to be constructed on a large scale, this would undoubtedly be the better plan, as magnets of that kind can be made of any required power, but for a small apparatus, intended merely to exhibit the motion, the plan here described is perhaps the most convenient.

Art. XVIII.—*Description and History of a new Plant, Túllia Pycnánthemoïdes;* by Melines Conklin Leavenworth, M. D. of Augusta, Ga. (With a drawing.)

TO THE EDITOR.

Waterbury, Ct. May 17th, 1831.

Dear Sir,—I transmit to you a description and drawing of an American plant, which hitherto appears to have evaded the researches of botanists. The generic name which I have bestowed upon it is commemorative, and in compliment to my friend, William Tully, M. D. Professor of Botany, Materia Medica, and Therapeutics, in Yale College, I believe, (with a single exception,) the earliest cultivator of scientific botany, under the Linnæan method, in the state of Connecticut. Yours Sir, very respectfully, etc.

M. C. Leavenworth.

DESCRIPTIO UBERIOR.

Caulis bi vel tripedalis, quadrangularis, subpubescens, supra medium ramosus; rami numerosi, axillares, subfastigiati, incano-tomentosi.

Folia subdistantia, opposita, petiolata; petiolis marginibusque ciliatis; lamina ovata, acuminata, basi attenuata, remote dentata, supra canescens, infra glaucescens.

Inflorescentia fasciculus spicarum secundarum axillaris, terminalisque; spicæ (externa facie) primo uniflor æ, postea productæ, et serie continuata, flores novos alternos confertos unibracteatos, producentes ad extremum pedunculorum; bracteis subulatis, longitudine calycis absque appendiculis dentium.

Calyx monosepalus, tubulosus, subventricosus, striatus, bilabiatus; labio superiore tridentato, inferiore bidentato, paulo breviore; dentibus erectis, subulatis (vel sublanceolatis,) subæqualibus, appendiculatis; appendiculis penicilliformibus.

Corolla monopetala ringens; tubo longitudine et forma calycis; labio superiore ovato-oblongiusculo, integerrimo, inferiore tripartito; lacinia intermedia longiore, pauloque latiore, margine subundulata.

Stamina quatuor, exserta, labio superiore paulo longiora, duo breviora; filamentis filiformibus, antheris subglobosis.

Ovaria (externa facie) quatuor, in fundo calycis.

Caryopsides? (non visæ.)

CHARACTER GENERICUS ESSENTIALIS.

Perianthium bilabiatum; labio superiore tridentato, inferiore bidentato; dentibus appendiculatis; corolla bilabiata; labio superiore integerrimo, inferiore tripartito; lacinia media majore.

This plant was found the 22d of October, 1830, when I was descending the Paint Mountain in Eastern Tennessee. It apparently commences flowering in August. When discovered, there were from two to four flowers upon each spike, which were of a delicate pale-rose color spotted with purple.

It is almost superfluous to state, after the full description which has been given of our plant, that it belongs to the natural order Labiatæ, which is characterized by *didynamous stamens, four caryopsides commonly called naked seeds, a single style, and an irregular corol.*

From the foregoing description, it will be equally evident that this plant belongs to the Linnæan class, *Didynamia*, and the order, *Gymnospermia*, and to that section of the *genera* which is characterized by a *calyx bilabiatus.* The characters of the several *genera* of this section (according to Sprengel's edition of the species Plantarum, which is perhaps the latest,) are as follow.

Lumnitzéra.—Cal. $\frac{1}{4}$ lab. super. ovato-incumbente. Corol. $\frac{3.4}{1}$ Stem. declinat. edentul.

Ocymum.—Cal. $\frac{1}{4}$ lab. super. subrotundo, incumbente. Corol. $\frac{4}{1}$ lab. infer. majore, porrecto. Stam. declinat. interiora basi processu instructa.

Plectránthus.—Cal. $\frac{1}{3.4}$, fructifer, basi gibbus. Corol. $\frac{3.4}{1}$, lab. infer. integro, porrecto, subconcavo. Stam. declinat. edentul.

Prunélla.—Cal. $\frac{3}{2}$, lab. super. plano, incumbente. Corol. $\frac{1}{3}$. Filamenta adscendentia, apice bidentata. Antheræ didymæ.

Melíssa.—Cal. $\frac{3}{2}$, lab. super. planiusculo. Corol. $\frac{1}{3}$, lab. super. fornicato, bifido, s. emarginato. Stam. adscendentia.

Dracocéphalum.—Cal. $\frac{3}{2}$, s. 5dentat. Corol. faux inflata.

Prásium.—Cal. $\frac{3}{2}$. Corol. $\frac{1}{3}$, lab. super. emarginato; inferioris lobo medio maximo. Caryopsides drupaceæ.

Phryma.—Cal. $\frac{3}{2}$, fructifer, reflexus; dentibus lab. super. elongatis, setaceis. Corol. $\frac{1}{3}$, lab. super. abbreviato; infer. porrecto. Caryopsis solitaria.

Cleónia.—Cal. $\frac{3}{2}$, lab. super. planiusculo. Corol. $\frac{2}{3}$, labii inferioris lobo medio emarginato. Filamenta apice bifurca. Stigma 4fidum. Caryopsides 4.

Trichostéma.—Cal. $\frac{2}{3}$, lab. infer. duplo majori. Corol. $\frac{3}{1}$, lab. infer. falcato. Filamenta longissima, incurva.

Thymus.—Cal. $\frac{3}{2}$, fauce villis clausa. Corol. $\frac{2}{3}$. Stamina adscendentia.

Gardóquia.—Cal. $\frac{3}{2}$, fauce nuda. Corol. $\frac{2}{3}$. Stam. distantia.

Thymbra.—Cal. $\frac{3}{2}$. Corol. $\frac{2}{3}$, lobis subæqualibus. Stylus bifidus.

Lepechínia.—Cal. $\frac{3}{2}$. Corol. $\frac{2}{3}$, calyci æqualis. Stam. distantia.

Clinopódium.—Cal. $\frac{3}{2}$, dentibus aristatis; involucris setaceis. Corol. $\frac{2}{3}$, lab. super. obcordato.

Melíttis.—Cal. $\frac{1}{2}$. Corol. $\frac{1}{3}$. Antheræ 2loculares, loculis superiorum super, inferiorum juxta se positis.

Scutellária.—Calycis labia indivisa, fructiferi clausa, superius operculatum. Corol. subpersonata.

Chilódia.—Cal. 2bracteat. $\frac{1}{2}$. Corol. $\frac{1}{3}$, lobo medio labii inferioris emarginato.

Prostanthéra.—Cal. lab. indivisa, fructiferi clausa. Corol. $\frac{2}{3}$, lab. infer. expanso, lobo medio 2lobo. Stam. declinata, antheræ calcaratæ.

Cryphia.—Cal. 2bracteat., labiis indivisis, fructifer clausus. Corol. inclusa $\frac{1}{3}$, lab. super. brevissimo, antheræ muticæ.

Perilómia.—Cal. labiis indivisis, dorso gibberoso, fructifer clausus. Corol. tubo arcuato $\frac{2}{3}$. Antheræ didymæ. Caryopsides alatæ.

Hemiándra.—Cal. $\frac{1}{2}$. Corol. $\frac{2}{3}$, labii infer. lobo medio 2lobo. Stam. adscendentia, antheris didymis, loculo altero casso.

Synándra.—Cal. $\frac{2}{2}$. Corol. $\frac{1}{3}$, fauce inflata. Filamenta tomentosa, antheræ superiores loculis superioribus cassis cohærentes."

From this synopsis it will be obvious that our plant can be referred to none of these *genera.* From that section of the *genera* which is characterized by a *calyx æqualis,* it is obviously excluded by the form of its perianth: but it seems to approach nearer to the *genus Pycnánthemum,* than to any other.

According to Michaux, the founder of that genus, its natural character, (in contradistinction from *Brachystémum,*) is as follows, viz:

" *Calyx* tubulosus, multistriatus, quinquefidus; dentibus erectis, semi-lanceolatis, seu subulatis.

Corolla,—tubus longitudine calycis; labium superius subrecurvo-porrectum, oblongiusculum, modice convexum, apice rotundatum, subintegrum; labium inferius multo majus, recurvo-patens; subcanaliculatum trifidum; laciniis lateralibus subsemiellipticis, intermedia longiore, pauloque latiore, nonnihil repandula.

Stamina exserta, distantia, duo labio superiori longitudine subæqualia, duo conspicue breviora; antheræ loculis subparallelis, etc.

Observatio.—Genus affine *Saturéiæ.*

Habitus.—Herbæ perennes seu suffrutices. Folia punctata. Capitula subsimplicia seu composita, multibracteata."

The natural character of Michaux's Genus *Brachystémum,* which has been since united with *Pycnánthemum,* is as follows:

" *Calyx* tubulosus; dentibus quinque brevibus, subæqualibus, erectis, acutis; fauce nuda.

Corolla.—tubus longitudide calycis, gracilis; labium superius breve, porrectum leviter emarginatum; labium inferius multoties amplius, patens, obtuse trilobum, intermedio productiore, subligulato-oblongo.

Stamina filamentis brevissimis inclusa, subæqualia.

Semina cylindraceo-oblonga.

Habitus.—Labiatæ perennes; folia puncticulosa; verticilli confertiflori seu capitula; bracteolis ciliatis."

The essential character of these two *genera* united, as given by Pursh, is " Involucrum multi-bracteatum, capitulis subjectum; calyx tubulatus striatus. Corollæ labium superius subintegrum, inferius trifidum. Stamina subæqualia."

Sprengel's essential character of these united genera is "Flores verticillati, bracteati. Calyx tubulosus, quinquefidus. Corolla $\frac{1}{3}$. Stamina subæqualia, inclusa vel exserta."

Our plant is therefore not a *Pycnánthemum*, either according to Michaux, Pursh, or Sprengel.

Art. XIX.—*Notice of the method of manufacturing the smoking Sulphuric Acid, as practiced at Nordhausen, Braunlage and Tanne, in Germany; by* Thomas G. Clemson—*in a letter to the Editor, dated Paris, April* 18, 1831.

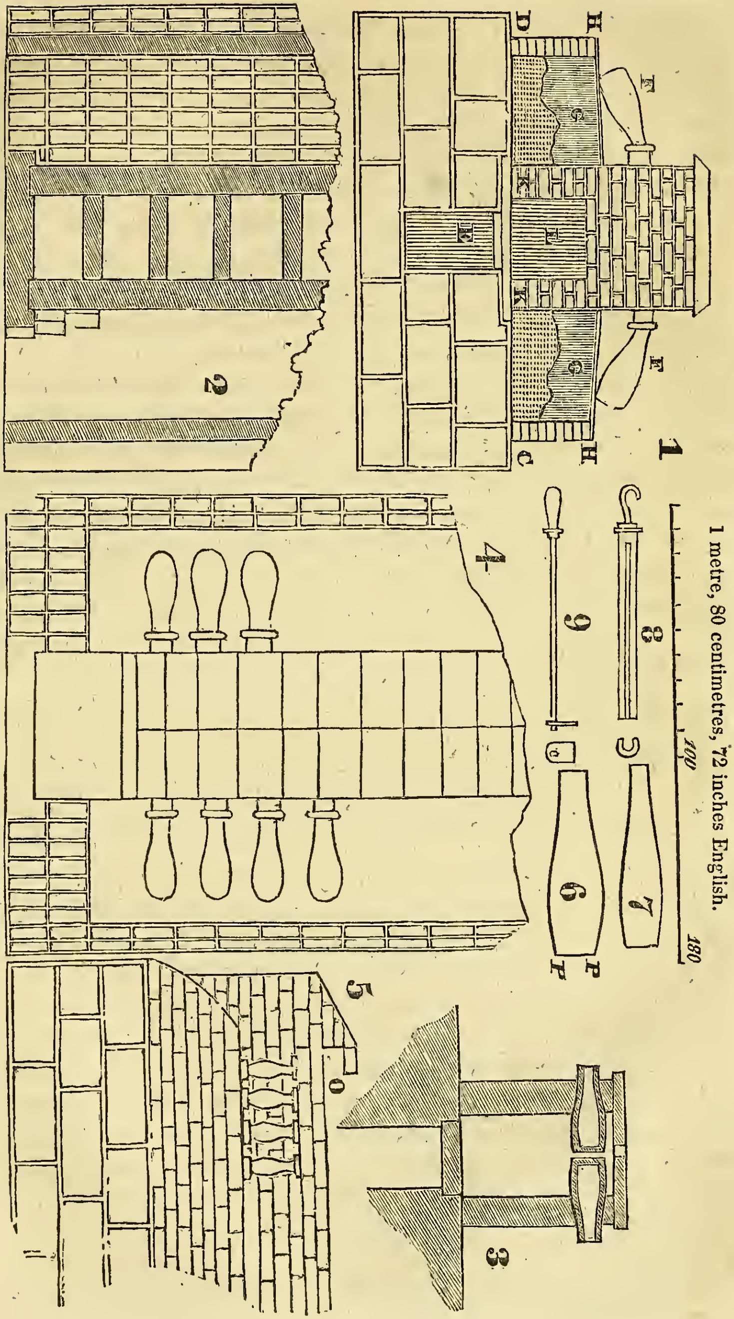
In the interior of our country, in places far distant from those in which sulphuric acid is manufactured in the ordinary way, its use becomes expensive in consequence of transportation; among these places, a coincidence of natural circumstances may permit of obtaining the acid with advantage from the sulphate of iron. The easy construction of the little necessary apparatus, the materials of which are every where present, and the little expense attendant thereon, together with its particular uses, may suffice to raise this species of industry, hitherto unknown, (at least to myself,) in the United States.

There are three Prussian towns, not far distant from each other, where this acid is made from the sulphate of iron; they are Nordhausen, Braunlage and Tanne. It is from the first named that this acid has taken one of its names; the two latter places are more happily situated than the first; they are surrounded by forests, which cover the highlands of the Hartz, and are not so far distant from the locality where the decomposed pyrites of the celebrated Ramelsberg are lixiviated. The oleum's hutté or manufactory of the smoking sulphuric acid of Nordhausen, stands on the road that leads from Zorge to Braunlage, not far distant from the latter place. The building is simple and of stone, ventilated by standing blinds in the lateral walls and roof, thus permitting the easy escape of smoke and other more deleterious vapors. The building contains four galleries or furnaces, and each gallery sixty four cylinders or retorts, with as many recipients. The whole is conducted by two workmen, the master and his son.

Fig. 1 is the elevation of the gallery. ABCD is the base, which is in stone, being 1 metre and 80 centimetres (72 inches English) in breadth from A to B, and 60 centimetres from B to C. E is the ash pit, being 35 by 20 centimetres. FF are the recipients, in position; they are adapted to the retorts, the position of which is seen in Fig. 3. GG are two chambers, constructed for efflorescing the sulphate of iron; thus giving an acid containing less water than otherwise would be obtained, provided the copperas was calcined in its natural state: they extend the entire length of the furnace and parallel with the fire hole: they are 40 centimetres from K to C, 34 from C to H, and 36 from I to K. IH is a plate of iron, supporting the recipients. The bars that support the combustible are in brick, having a thickness of 3 centimetres. The extreme height of the front elevation is 150 centimetres. The whole length of the gallery is 4 metres.

Fig. 2 is a horizontal cut, following CD. Fig. 3 is a perpendicular cut, showing the position of the retorts. Fig. 4 is the plan. Fig. 5 is a side elevation, having no other conductor for the smoke than is seen in O, passing off through the side and superior ventilators of the building. Fig. 6 is the retort, represented on double the scale; from P to P =10 centimetres, 8 at the mouth, (S,) and from P to S =38 centimetres. The recipient differs little from the retort; it is fig. 7, the mouth of which should enter the aperture of the retort. The recipients are in stone ware and support the fire well. Fig. 8 is the charging spoon, having a length of 45 centimetres; it has a groove running nearly the length of the instrument, represented in the cut. Fig. 9 is the scraper used for cleansing the retort of the colcothar.

The retorts remain in their horizontal position until they are broken, or until the necessity of making other repairs requires their removal. They are charged with the white sulphate of iron, by the means of the spoon represented. The recipient is then adapted and the whole luted, with a mixture of saw dust and clay. In this state the gallery is heated; wood is the combustible employed; the fire is kept up for twenty four hours. The charge for each retort is 2 lbs. or 128 lbs. for a gallery, giving from 70 to 79 lbs. of smoking sulphuric acid. This result is not constant; frequently much less is obtained. To obtain a like product the wood should be dry and the fire well conducted, otherwise on inspection, some of the retorts will be found to contain a weak acid and in less quantity. Those of the recipients which contain a weak acid are known by their not smoking; it is distributed in this state, by piece-meal, into the other products. The twenty four hours having expired, the fire is suffered to fall; when sufficiently cool, the lute that attaches the recipient to the


1 metre, 80 centimetres, 72 inches English.
100
180

retort is broken,* and the acid thrown into large stone ware jars and thus sold. The colcothar is extracted from the retorts by means of the scraper; it is of a dark red color, having occasionally a yellowish hue, which indicates but a partial decomposition. This oxide is sent back to Goslar, where it is manufactured into ochre. Those of the retorts that are no longer fit for service are replaced. Twenty four hours suffice for collecting the acid, and making the necessary preparations for a new operation. The quantity of sulphate of iron employed in each charge, is always effloresced in the lateral chambers, by a preceding heat. Thus each furnace is heated three times per week, leaving the workmen at liberty the seventh day.

The depot of this acid is at Frankfort, on the Mayne; in Paris its first cost is forty sols the pound. The sulphate of iron costs 1 thaler and 12 bons groschens the quintal. The four furnaces consume at one distillation seven matters of wood, giving a quantity of acid, according to the manner that the distillation has been conducted, from 200 to 260 lbs. which is sold at 15 bons groschens the pound. The colcothar sells for 12 bons groschens the 5 quintals. The cylinders last a very long time; thus the expenses for breaking are trifling.

Art. XX.—*Observations and Experiments on the phenomena developed by Light, in its passage through small apertures; with remarks on some of the received theories, and an investigation into the cause of prismatic analysis; by* Columbus C. Conwell, M.D.

TO THE EDITOR.

The experiments and observations contained in the following paper, relate to the partial decomposition which light undergoes in passing through small orifices, and impinging on the surfaces of bodies, and to other phenomena of vision. Although the subject has long exercised the ingenuity and industry of studious minds, the phenomena appear to be inconsistent with the existing hypotheses. Without recapitulating theories, or citing the authorities by which they are sustained, I proceed to the statement of the following facts, happy if I have augmented the number of exact observations, and thus aided in any degree in advancing this interesting branch of science.

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* The lute is moistened and reserved.

Images transmitted to the retina through a puncture made by the point of a fine needle in a piece of sheet lead, do not appear so distinct or luminous as when viewed by the naked eye; but seem to be enveloped in a hazy brownness, whose intensity is inversely as the width of the aperture. The solar spectrum viewed through this puncture loses much of its brilliancy, and the nice distinction between the colors can no longer be observed. Whether the small aperture be angular or slightly elliptic, it will, when applied close to the eye, invariably present the figure of a perfect geometrical circle. If the aperture be an incision of a line in length, it will assume the figure of an oblong, rounded at its two extremities. The size of these circles does not depend entirely on their proximity to the eye, but on the contraction and dilatation of the pupil.

When a number of punctures are made in the lead, at the distance of one sixteenth of an inch from one another, and gradually approached to the eye, the opaque interval between them diminishes as their diameters increase, till at length it is obliterated, and the whole appears diaphanous and filled with perfect circles cutting one another. But the most paradoxical appearance attending this experiment is, that the circumferences of these cutting circles, which receive at least doubly as much light as their centres, are distinctly dark, while their centres are illuminated. This anomaly is somewhat analogous to that discovered by Grimaldi, whilst studying the inflection of light: viz. "that a body actually illuminated may become more dark by adding a new light to that which it already receives."

When a number of long parallel apertures, about half a line apart, are cut with the point of a penknife through a plate of lead, and applied close to the eye, no opaque interval will be found. A similar phenomenon occurs when a small body, as a wire or needle, is gradually approximated to the eye. Thus, if we close one eye and raise a needle, by degrees, from the page of a book, towards the other, the needle will appear as it approaches the eye, to lose imperceptibly its density and opacity, till at last it will become diaphanous, letters being visible through it, and nothing of it remaining but a diffused shadow or penumbra. This illusory transparency may be observed to occur in cylinders of even a line in diameter. It is moreover to be remarked that the shadow (if so we may term it,) into which the body appears to resolve itself, is imbued with the color of the body. If we look at the page of a book through a thick wire painted black, the letters within the shadow will seem dark and denigrated; but if we look through a white wire at a black surface, it will appear whitish, In looking through the long aperture, placed at a short distance from the eye, dark and bright lines, such as are seen bordering shadows and supposed to be deflected from bodies, will appear running parallel to the fissure. Having closed one eye, if we apply the long aperture in such a manner to the other that the pupil shall be nearly covered, and then direct the glance to a luminous object, it will appear beautifully bordered with chromatic light. The uniform development of color along the edges of bodies, led to some experiments, instituted for the purpose of examining, under various circumstances, this phenomenon. From among them I select the following as being curious and anomalous: close one eye, and with the other look steadfastly at any luminous object, as the flame of a candle or an illumated window; then move an opaque body (for example the finger,) gradually across the eye; and when the pupil is nearly covered, the candle flame will appear to glow with the primitive colors. The moon viewed in this manner presents a beautiful and splendid spectacle. It is remarkable in this experiment that the colois, supposed to be compound, viz. the orange, green and indigo, are more copiously and distinctly developed than the primary ones. Whether the opaque body be black or white, the same unaccountable appearance will be produced.

When the sun is viewed through a puncture, the transmitted white light is resolved into its elementary hues, and the colors are seen emanating *separately* from the sun.

If we apply the long aperture to the eye, and hold a needle at a short distance behind it, it will form a curve, which being gradually brought closer to the eye, will enlarge into the seeming shadow before spoken of; but if we place behind the long aperture a broader body, as the flat side of a penknife blade, it will appear cut on either side by a semicircle, thus describing a space between two circles. In passing through a small circular aperture, the image of a candle flame received on a white surface, will be found *inverted*, and if the white surface be held at some distance, the image will be exceedingly magnified, as in the case of its transmission through a double convex lens. In other instances the small aperture displays the properties of a double concave glass, as in giving distinctness and achromacy to telescopic images. When the image of a candle flame is transmitted through a long incision in the lead, it will be *multiplied* and present the appearance of a row of lights all inverted. If a plate of lead having many punctures be held close to a candle flame, and a white surface placed at some distance behind it, each puncture will be seen to contain a perfect image of the flame.

The small circular aperture displays some singular appearances, when allowed to transmit dispersed light. Thus, place in a sun beam, admitted through a hole in a dark chamber, a spherical mirror* of about four lines in diameter, and near it, place in the dispersed rays, a leaden plate containing a few punctures. At a convenient distance receive on a white surface the shadow of the plate, and the following phenomena will be evident: each puncture will contain a number of dark circular lines or epicycles, with luminous intervals between them. On minute examination these lines will be found chromatic, being bordered on the one side by orange, and on the other by bluish light. When the holes in the lead are square or rhombic, the images received on paper will be found to comprise many smaller squares or rhombs. The development of dark and bright lines is not occasioned by a property, exclusively belonging to heterogeneous light; for when we admit into the dark chamber a beam through red or blue glass, and adjust in it the spherical mirror and punctured plate, the same dark and bright circles are observed; but instead of the chromatic fringes that border the circles in compound light, we shall only perceive dilutions and concentrations of the color employed.

The homogeneous rays emerging from a prism, being transmitted through holes in the leaden plate, present some appearances well worthy of notice. Having admitted a beam of white light into a dark chamber, through a hole half an inch wide, I ordered a prism in such a manner as to decompose the light, and placed in the emerging rays, at some distance from the prism, a plate of lead, having in it a hole of one line in diameter. At a distance of four feet from the lead, I held a sheet of white paper, expecting to find on the paper the base of a luminous cone, such as would be formed by white light under the same circumstances; instead of which, there appeared from the lead to the white surface *a pyramid of light* whose base on the paper described an oblong figure, bounded on all sides by straight lines. On varying the position of the prism, so as to let the refracted rays emerge at different angles from the incident rays, the

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* This experiment ought to be performed with a metallic reflector. The bulb of a thermometer answers the purpose, but not so well as metal, since the light is liable to be decomposed by the slightest inequality of the glass.

figure of the pyramid was varied, and the base on the paper described, according to the position of the prism, a square, a rhomb, a rhomboid, a trapezium, or a parallelogram. All the figures were quadrilateral, and terminated by right lines. These phenomena would lead us to consider the spectrum in an entirely new light; for if we admit the Newtonian hypothesis, that it consists of circular images of the sun, the appearance of these luminous pyramids must remain inexplicable. The idea that the spectrum consists of monochromatic circles, the diameter of one of which forms its breadth, and whose circumferences bound it on all sides, is a beautiful conception, but it appears inconsistent with the luminous pyramids, and with the following fact, which I accidentally discovered. Whilst experimenting on the effects of transmitting the analyzed rays emerging from a prism, in a dark room, through a bi-convex lens, I chanced to interpose the lens between the sun and the prism, in such a manner that the focus fell on the prism near its refracting angle. On the opposite wall I was surprised to see a spectrum of a very peculiar and novel appearance. The proportion between its length and breadth exactly corresponded to that of the Newtonian Spectrum, it being about five times longer than it was broad; but unlike the Newtonian image, its length lay in a direction parallel with the length of the prism. In this spectrum the colors are arranged *longitudinally*, in the order of the common spectrum, and consequently all the dimensions of the common one are reversed in this. Newton, from the circumstance of his not having succeeded in attempts to increase the breadth of the spectrum, concluded that its breadth was the diameter of one monochromatic circle; but if we grant that the breadth of this spectrum is formed by the diameter of a colored circle, we must admit that that circle is painted with the seven primitive colors, which, from a consideration of both spectra, would be absurd. The lines bounding the extremities of the common spectrum, form the lateral boundaries of this new one; and its extremities are terminated by lines, which bound the long sides of the Newtonian spectrum. The lines which bound the extremities of the common spectrum are so produced in this image as to terminate its long sides with straight lines; and as it is certain that a curve line on being produced cannot form a straight line, so it is certain that all the boundaries of the solar spectrum are right lines. In order to examine this spectrum minutely, the prism should be fixed on a stand, the lens mounted on a swivel, and the white surface placed at a suitable distance from the prism, which, considering the divergent power of the lens beyond its focus, should be much nearer than is requisite for examining the common spectrum. The prism employed is very liable to be broken, from the quantity of heat concentrated on it by the lens.

The luminous pyramids before spoken of are probably images of the prism, which pass in minature through the foramina in the leaden plate, and augment in magnitude as their distance from the lead increases; for when, instead of using the homogeneous rays issuing from a prism, we place red or blue glass in the aperture through which the solar beam is admitted, and allow the rays to pass through holes in a plate of lead; on receiving the images on paper at some distance from the metal, we shall find them to be perfectly circular.

It has been maintained by a few of those who have written on the inflection of light, that some of the calorific rays are more diffrangible than others, and as a corollary to this, it follows that differently colored rays, after passing through punctures of equal diameters will form figures whose bases, if received on a white surface, will appear of different sizes. To ascertain the truth of this position, the following experiments were performed.

A plate of red glass was placed in the aperture in the window shutter; and at the distance of a couple of feet from it, was fixed a sheet of lead, having in it a round hole of a line in diameter. The boundaries of the base of the cone formed by the rays, were accurately marked with a crayon on a sheet of white paper, at the distance of twelve feet from the leaden plate. On substituting blue for red glass in the window shutter, the base of the blue cone was found to occupy precisely the same space on paper as that of the red one. Yellow and violet glasses were employed, and the cones which they formed were equal to those produced by red and blue. It is to be remarked that these monochromatic cones do not differ in magnitude from the cone formed by compound solar light. The colored fringes observed round the base of the cone of white light, cannot of course be observed around the base of the monochromatic cone; but instead of them, appear rings of different intensities of color: towards the centre of the base the color is bright but dilute, and dark but concentrated around the circumference.

Lest the equality in the size of the cones might be supposed to arise from any difference or imperfection in the colored media, I received the analyzed rays, emerging from a prism, on a sheet of lead, pierced with holes of nearly a line in diameter, at equal distances from one another, (about an inch,) and in the same line. The bases of the pyramids, formed by the insulated colors, being received on paper, were found to occupy exactly the same spaces, and to be equal to one another.* The rays of the different colors are, therefore, all *equally diffrangible.*

The shadows of bodies in homogeneous light, instead of being fringed with colors, as in compound light, are bordered by concentrations of the color in which they are placed; and the luminous streak around the border appears to be even more distinctly developed in monochromatic than in white light.

Having always entertained some doubts about the different refrangibilities of the colorific rays, notwithstanding the high philosophical authority from which the theory emanated, I instituted a few obvious experiments for the purpose of settling my mind on the subject. Before stating them, I beg leave to make a few introductory remarks. It is established that when the solar rays are transmitted through a double convex lens, to a focal point, their convergency is caused by the refraction which the rays undergo in the glass; and hence it necessarily follows that the distance of the focus from the lens is inversely as the degree of refrangibility possessed by the light. In other words, if light were more refrangible than it really is, its rays would converge sooner to a focal point than they do, the same lens being employed. Now according to the Newtonian doctrine, there is a gradation of refrangibilities from the red to the violet rays; the rays of the latter being most refrangible, those of the former being least so, and the colors included between these extremes, possessing intermediate degrees of refrangibility. It naturally follows that when the same double convex glass is used, the point of convergency or focus will be nearest the lens in the violet rays, less near to it in the indigo, still less so in the blue, and so on to the red rays, in which the distance of the focus from the glass must be greatest, since they possess less refrangibility than any of the other rays. Impressed with these views, I obtained a double convex lens whose focal distance in the compound solar light was two feet, and mounted it on a sliding stick, accurately graduated. Having decomposed, by a prism,

* The bases formed by the superior yellow rays and the inferior green, appear, when viewed at a distance, to be larger than the rest, but this arises from their greater illuminating power, by which they illustrate a space contiguous to them.

the solar light entering a dark chamber, I fixed the lens thus adjusted in the isolated red rays, which were refracted in their passage through the lens, and made to converge to a focal point at precisely twenty four inches from the glass. The lens was then fixed in the violet rays, which having passed through it, converged to a focus at exactly twenty four inches from it. The orange, yellow, green, blue, and indigo rays were passed separately through the lens, and all made to converge to one focus. A bi-convex glass, whose focal distance is four feet, was subsequently employed, and gave results scrupulously analogous to those already stated: all the differently colored rays converging at the same distance from the lens.

Double concave glasses were used to determine whether the divergent rays of the different colors would form circles of equal diameters, at the same distance from the lens. The circumference of the circle formed by the divergency of the red rays was accurately marked with a pencil on letter paper, and the circle produced by the violet rays was found to have, at an equal distance, the same diameter. These experiments are obvious and simple, and they go to establish that *the rays of all colors are equally refrangible.*

If we admit that the several colorific rays are endowed with different degrees of refrangibility, we must be prepared to admit the following results, as the necessary consequence of such a property.

1. A beam of white light, in passing through a diaphanous medium of equal thickness, as a plate of glass, with parallel surfaces, would undergo analysis, and the colors would appear in the order of their refrangibilities.

2. Bodies viewed through different colors of light would appear of different magnitudes; for the focal distance of the crystalline lens would vary, according to the refrangibility of the rays.

3. A double convex glass would have seven foci; for the violet rays, being most refrangible, would converge soonest to a focus, and the red rays, being least so, would form the most distant one. If, therefore, the violet focus were received on paper, it would be seen surrounded with six circles of colored light, of which the red would form the external.

4. The same chromatic circles would appear, if solar light were transmitted through a double concave glass; with this difference, that in the latter case, the center would be formed of the least refrangible or red ray, and the circumference of the violet.

5. The bed of a river, or a picture behind a plate of glass, would be seen beautifully enamelled with spectra.

These, and many more phenomena of a similar nature, would be manifest, if the colorific rays possessed different degrees of refrangibility; but as no such appearances are observed to take place, it follows that the colorific rays are all equal in point of refrangibility. In order, therefore, to account for the prismatic analysis of the solar rays, we must seek for some other cause than the different refrangibilities of the colors of light.

A theory which appears to me to be less objectionable than any already advanced, more consistent with phenomena, and more conformable to facts, is the following.

It is manifest, even to the organ of vision, that there exists, on the solar spectrum, a gradation of densities from the red to the violet rays; the former being most dense, the latter most rare, and the colors included between these extremes possessing intermediate degrees of density.* As a corollary to this, it follows that the attraction existing between homogeneous colorific atoms is most energetic in the red, and most feeble in the violet rays. This density, or concentration of colorific atoms, varies not only in rays of different colors, but in different rays of the same color. This may readily be proved. Into a dark chamber admit a sun beam through red glass, and fix the prism in such a manner as to refract the rays; receive the image on a white surface at a distance, and it will be seen that the red color is most concentrated at the base, and becomes gradually less dense from the lower to the upper extremity of the image. Lest this phenomenon might have arisen from any inequalities in the substance or polish of the colored medium, I admitted into a dark chamber, the red rays, emerging from a prism, and having refracted them by a second prism, I received the image on a white paper. It differed in no respect from that produced by red glass. In this experiment it is to be remarked that the image is not circular, as Newton imagined, but quadrilateral. The quantity of heat, which accompanies the different colors of light, appears to depend on the density of the colorific ray, and to be proportional to it; for, as we proceed upward on the solar spectrum with the differential thermometer, a decrement of sen-

* Sir Isaac Newton was of opinion that the particles of red light were not only more contiguous to one another, but larger than those of the other colors, and consequently that they possessed a greater specific gravity.

sible coloric is indicated, and this, I have observed, not only in differently colorific rays, but in different rays of the same color: thus, by transmitting a beam of red light through colored glass, and causing it to be refracted as in the foregoing experiment, it will be found, by a delicate thermometer, that the heat is greater at the base than at the summit of the image. The development of caloric* is, therefore, directly as the density of the colorific rays. Now when a beam of white light is incident on a dense diaphanous medium of unequal thickness, such as the prism, its red rays, as they possess the greatest density, and hence penetrate glass with greater difficulty than the rarer rays, are trajected through the thinnest portion of the prism, which they permeate with most facility. Having passed through less of the glass than their concomitant colors, they will consequently be less refracted, and occupy the base of the spectrum. The orange rays, being next in the order of density, pass through the next thinnest portion of the prism, and having permeated a part of the glass, thicker than the red, and thinner than the yellow rays, they undergo

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* When we introduce a pencil of red rays into a dark chamber through a plate of colored glass, the thermometer being placed in them, indicates a higher temperature than in blue or violet light, admitted through colored glasses; but it would be preposterous to conclude that, because more heat is found in red than in blue light, this difference is owing to the circumstance of the calorific rays being less refracted by red than by blue glass, or that heat consists of differently refrangible rays. A more gratuitous conclusion cannot easily be imagined; for what proportion exists between copiousness of heat and refrangibility? were the rays of caloric differently refrangible, why recur to *glass prisms* to prove it? or what analogy is there between bodies that transmit light, and those which transmit or conduct caloric? Indeed these properties generally occur in bodies in inverse proportion with regard to each other. If the rays of caloric were differently refrangible, metallic prisms, particularly silver ones, would answer the purpose of measuring the degrees of their refrangibility much better than glass ones, since they are much more perfect conductors of coloric.† Far from having any proof that the rays of heat are differently refrangible, we have not a single fact to countenance the opinion that, *per se*, they undergo refraction at all.

For when a beam of heat strikes on a piece of silver, in the shape of a double convex lens, the thermometer does not indicate any focus or concentration of calorific rays. I may here mention an experiment which cost me much trouble. It was instituted with a view of ascertaining, whether the rays of heat, after passing through a conducting medium of metal, shaped like a burning glass, would converge to a focal point. A circular piece of glass was cut with a diamond, out of the middle of a plane mirror, and in the hole was fixed a double convex lens of silver which exactly fitted it. The mirror was mounted perpendicularly on a supporter, and an-

† Does the refrangibility depend on the conducting power? heat is hardly conducted by water at all, solar heat instantly radiates through that fluid.

an intermediate refraction, and must necessarily occupy, on the spectrum, a position between the red and the yellow. The violet rays, being most rare, penetrate the thickest part of the prism, and consequently, being most refracted, must occupy the summit of the spectrum. It would follow, from this theory, that a beam of white light, in permeating a double convex lens, would undergo analysis, and paint many spectra, on a white surface at some distance from its focus, since the lens is of unequal thickness. Such is really the case, though the colors produced cannot separately affect the retina, from the circumstance of their being developed in so many points of the lens, and blending so intimately together as to make white light. But that light is decomposed by the lens, may be proved thus: Attach to the back of the lens a disk of sheet lead having any number of punctures, and let a beam of light, entering a dark chamber, strike on the lead; at some distance beyond the focus, hold a sheet of letter paper, and the image of each hole in the disk will be seen occupied by a spectrum, glowing with the primitive colors. The

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other column was placed near it, and facing the mirror, to support an iron globe. Things were so ordered that, on heating the iron ball, all the calorific rays, incident on the mirror, would be reflected, and those only, which fell on the silver lens, would be transmitted. On subjecting the globe to an incandescent heat, I held the bulb of a thermometer in the spot where the focus would be, if a beam of light were refracted through a diaphanous lens of the same dimensions; but the thermometer did not there indicate a higher temperature than in any other spot, equidistant from the metallic lens and within the cone of radiation. Nor did the unequal thickness of the lens appear to affect, in any degree, the intensity of the transmitted heat. This experiment, which was cautiously performed, has convinced me that caloric, *per se*, is not subject to the laws of refraction. When united with light, in a combination which may be called *chemical*, it accompanies its rays as a necessary and indispensable agent. The combination of caloric with the red rays seems to be in a certain invariable ratio above the surrounding temperature, and that ratio is directly as the density of the colorific rays. It becomes thus, easy to account for the inequality of heat presented on the spectrum, or transmitted through glasses of different colors or lenses, when we reflect that caloric is held, chemically combined with the atoms of each color of light, and the more the colorific rays are condensed, the more sensibly will their caloric be developed. That heat should be found beneath the apparent base of the spectrum may seem at first paradoxical; but when it is recollected, that the illuminating, or properly *lucific* rays, through which alone objects are visible, are totally distinct from the colorific rays, the anomaly immediately vanishes. For the densest rays may be collected where sensible caloric predominates, and still be invisible to us, from the circumstance of their not being combined with the illuminating rays. That a fluid, like caloric, perfectly homogeneous in all its parts, and producing uniformly the same effects, should consist of differently refrangible rays, is an hypothesis, so diametrically repugnant to all philosophical principles, that it is wonderful it should have received a moment's consideration.

same phenomenon, still more brilliantly and vividly developed, will appear, when, instead of the lens, we employ a concave glass speculum. In the same manner, if we affix to the prism a plate of punctured lead and allow a solar beam to pass through, we may behold, at a slight distance from the prism, as many spectra as there are punctures in the lead.

Art. XXI.—*On Storms and Meteorological Observations;* by Prof. Mitchell, Univ. N. C.

ON THE POSITION OF THE AXIS OF GYRATION IN STORMS.

In the 40th number of this Journal an attempt was made to show that certain winds, and amongst other storms those of the Atlantic coast are the result of a gyratory movement of the air about an axis parallel to the plane of the horizon. In a paper by Mr. Redfield in the last or 41st number, whilst the correctness of the views just referred to, so far as thunder storms are concerned, is allowed, it is contended that in the great tempests that sweep along our sea board, the gyration is about an axis either perpendicular or moderately inclined to the horizon. The author of the first of these communications does not find himself warranted in abandoning the opinions originally advanced by him, and begs leave here to offer the following additional remarks.

A sound theory of storms must fulfil three conditions.

1. It must account for the characteristics of the wind which constitutes an important part, though by no means the whole of the phenomena, its direction, velocity, etc.

2. It must account for the precipitation of moisture under the form whether of rain, hail, or snow.

3. The motion ascribed by it to the aerial currents must be such as the causes known to be active upon the earth's surface, have a tendency to generate.

In my own paper, each of these points received particular though perhaps not satisfactory notice, and I should not have ventured to offer it for publication if I had not *supposed* that the theory contained in it was shown to satisfy the three conditions. Mr. Redfield's attention is directed almost exclusively to the course, velocity, and changes of the *wind*. His theory does not and cannot account for the rain and snow, and that the motion ascribed by it to the air is such as the causes known to be active upon the earth's surface can seldom or never produce, at least, upon the scale that he supposes.

1′. It may be objected to the opinions advanced in Mr. Redfield's paper, that the induction upon which they are founded is too narrow, embracing too small a number of particular observations, and these too slightly connected to warrant the conclusions that are drawn from them. The phenomena stated may all be explained upon the supposition of a whirlwind revolving about a horizontal axis. The principal movement of a revolving fluid is almost necessarily accompanied by various eddies, counter currents, and motions in an opposite direction, and especially must this be the case during the commotion produced by the precipitations and rapid and violent mixtures of air of different temperatures that constitute a furious storm. A good deal of stress is also laid upon the fact, that in certain specified cases, a violent wind from the N. E., E. S. E. S. or S. W. quarter was succeeded by another from the *north west.* But did this north west wind by sinking down into a calm, *after having continued for as long a time as the wind that preceded it*, prove itself to be a portion of a retiring whirlwind? Or did it continue for a longer time—two or three days—with clear weather, and thus shew that it was the first burst of an aerial torrent, by which the current, natural to this part of the earth's surface, was established. When a case shall be adduced where a wind from some other quarter *succeeded* one from the north west as part of the same storm, the argument drawn from the changes remarked in the course of the wind, will be entitled to more weight and confidence.

It may be observed farther that in the storms *which sweep over the land*, and which are of such moderate dimensions, that the direction of the constituent wind can be easily and accurately ascertained; whirlwinds are of rare occurrence. It is probable, therefore, that the same is true of such tempests as are of larger dimensions, and whose route is either in part or altogether over the ocean. It is a sound rule in philosophy, that when any phenomena, from their vastness or for any other cause, cannot be accurately observed, their character is to be inferred from analogous phenomena that are within the reach of observation.

2.′ It is manifest that *what has always been regarded as a principal difficulty* in accounting for the phenomena of storms—the furnishing an explanation of the precipitation of moisture, with the immense evolution of latent heat, and the depression of temperature which does, nevertheless, in very many cases accompany it—is not touched at all by Mr. Redfield's theory. The problem to be solved in this part of meteorology, is the bringing of large masses of air of very different temperatures suddenly into a state of intimate mixture. But no such effects could be produced by a whirlwind with a vertical axis, which might continue to spin for ages without producing a single drop of rain. It was with reference to this difficulty especially, that an horizontal axis of gyration was ascribed to storms in my own paper, and on this one point the whole question may be safely rested.

3′. Though condensation and rarefaction may not in every instance produce a wind, there are no other known agents by which any considerable movements in the great aerial ocean can be generated; and nothing is more certain than that the only motion they have a *direct* tendency to produce is gyratory, and about an horizontal axis. This is matter of demonstration. If they ever produce whirlwinds with vertical axes it must be by an indirect action, and it does not seem safe to assign to phenomena of common occurrence, causes which act indirectly, and of which there is no full and positive evidence that they have ever generated such a whirlwind half a dozen miles in diameter. Nor must it be claimed that there are peculiarities in the form and positions of the mountains, seas, and islands of the western continent, which will determine the formation of whirlwinds of a peculiar character, with us, rather than in other parts of the globe. Storms are of common occurrence the world over, their characteristics are every where much the same, nor is there room for doubt that they are every where regulated by the same general laws and to be referred to the same general causes.

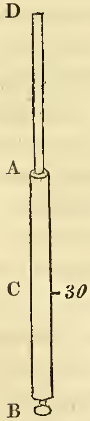
OF METEOROLOGICAL OBSERVATIONS.

Mr. Redfield has unquestionably fallen upon the proper method (too much neglected in this country since Franklin's time,) of arriving at valuable and accurate results in meteorology. It is by tracing the progress of particular storms and noticing the succession of changes over a wide district of country, that we must ascertain the laws that regulate the atmospherical phenomena. The collections of meteorological tables, registers, and observations, under which the shelves of our libraries have long groaned, are almost worthless; partly by reason of the imperfections of the instruments employed, partly because the objects aimed at may be gained by shorter methods, and partly because they are directed to the acquisition of *mean* *results.* It is not meant to be asserted that mean results are of *no* value, but we must not hope to deduce many of the great laws of nature from them. This were much as if a chemist should set down in a table all the acid, alkali, alcohol, etc. consumed in his laboratory in the course of the year, with all the resulting substances of whatever kind, and undertake to derive from these data the great fundamental doctrines of his science.

No record of the height of the mercury in the barometer can be of value unless the instrument is both carefully purged of air and *filled with mercury whose specific gravity has been correctly ascertained.* It is somewhat remarkable, when we consider the many laborious observations that have been made in various parts of the world, the plans that have been proposed for clearing the tube completely of air, and the contrivances added for reading off the altitude to the thousandth part of an inch, that the constant and perhaps necessary uncertainty of the standard itself should have been so much neglected. The mercury employed by Mr. Daniell in filling the tube of the barometer recently made for the Royal Society, was found by Mr. Faraday to have a specific gravity of 13.624 at 40° of Fahrenheit's thermometer, *the temperature of the water being the same*—or of 13.609 at the temperature of 60°. He states the mean height of the barometer in London at 29.881 inches. But Dr. Henry in the last edition of his Chemistry makes the specific gravity of mercury 13.545 at 47° of Fahrenheit, or 13.538 at 60°. If Daniell's mean altitude was obtained with the same metal, or with a metal of the same specific gravity with that employed in filling the Royal Society's barometer; the mean height with Dr. Henry's mercury would be 30.038. But Dr. Thomson, remarking that the specific gravity of mercury "*varies considerably like that of all other metals,*" says that he once obtained it as low as 13.4228. This would stand according to Daniell at 30.295. We have therefore the following numbers:

Height of the barometer in London as deduced by Luke Howard from the register kept at the rooms of the Royal Society, a mean of twenty years, - - - -	29.8655
Height stated by Daniell—supposed specific gravity of the mercury, 13.609, - - -	29.881
Height with Dr. Henry's mercury—same pressure,	30.038
Height with Dr. Thompson's mercury, - -	30.295
Uncertainty depending upon the variable specific gravity of the mercury, - - - -	.4295

Dr. Young states that mercury once distilled has a specific gravity varying from 13.55 to 13.57—that the mercury employed in filling barometers has *commonly!* a specific gravity of 13.6, and that Boerhaave by 511 distillations once obtained it as high as 14.11. What would be the condition of the science of astronomy if an able philosopher were to find occasion for the remark, that the arc employed by astronomers in measuring the angular distances of the heavenly bodies and divided by them into ninety degrees was *commonly* a quadrant or quarter of a circle? The low state of the mercury in Dr. Hildreth's barometer noticed in the last number of the Journal, may depend in part upon the specific gravity of the metal with which it is filled. Whether these discrepancies depend upon the presence of a foreign substance or supposing the mercury to be pure; by what methods a given specific gravity may be obtained seems not to have been made the subject of accurate investigation. The other sources of error depending on the presence of air in the tube; the unequal pressure of the bag containing the mercury, etc. are not particularly noticed here, but it is evident that the *mean results* given by an instrument that is rendered by their combined influence so very variable and uncertain in its indications as the common barometer, must be of little value.*



* It has occurred to me that when a considerable manufacture of barometers is carried on, the arrangement in the margin might be employed with advantage for filling them in vacuo, boiling the mercury and thus freeing them completely of air. AB is a gun barrel carefully polished on its interior surface, and furnished with a hollow screw having a square nut for the purpose of forcing it down with a key and making an air-tight joint at A, and with a smaller solid screw at B. The barometer tube, thoroughly dried, is to be cemented into the hollow screw and connected with the barrel as in the figure. Mercury is then to be poured in at B until the compound tube is full. The solid screw is then to be put into its place, the apparatus inverted with the bottom in a basin of mercury, and the screw removed, when the mercury will flow out until it stands at C, about thirty inches above B. The screw may then be returned to its place again and the mercury boiled in vacuo. When it has become cool, a second immersion will cause the mercury to flow into the *glass tube* which will thus be filled in vacuo with mercury thoroughly freed from air without any danger of fracture. As however, the vacuum above C, would not be *quite perfect* in the first instance, the operation might be repeated. The tube being filled again at B and inverted, all the metal containing air would flow out first, and the success of the process be rendered complete and certain. To prevent the oxidation of the iron and dust from getting in, the barrel may be kept constantly filled with mercury.

The mean temperature of any place is so very readily ascertained and with so much certainty by means of a few observations upon its wells and springs, made within the compass of a single year, that it seems a very useless waste of time and attention to watch, and record with reference to this object, the indications of a thermometer exposed to the air.

The columns for the direction of the winds, for the aspect of the heavens and the amount of rain, that appear in the best meteorological registers are not without their value, but their usefulness would be very much increased if measures were instituted for effecting an immediate comparison of them with the observations made in other and distant parts of the country. When observations with the hygrometer shall have been sufficiently multiplied to warrant us in drawing conclusions from them, it will probably appear that the quantity of vapor is less on the western than on the eastern side of the Atlantic—that though the amount of precipitation is greater the air is considerably drier.

It is however by a minute and thorough study of individual phenomena, and tracing the progress of the changes that occur from time to time over a wide extent of country, that the science of meteorology is to be perfected. The truth of the proposition stated by Leibnitz—"*Neque aliud est natüra quam ars quaedam magna*," is to be borne constantly in mind. Every great storm is a succession of chemical changes, immense alike in their number, magnitude, and the space through which they occur, and as it is by a close attention to all the circumstances of single experiments, and not by a loose and indefinite approximation of a number, that chemistry has made such astonishing advances, so meteorology, if studied at all with success, must be pursued in the same way, the labors of many different persons being combined in the collection of data, where the observations of a single individual would be inadequate to the attainment of the object in view.

It is not known whether the plan sketched in the following letter of Professor Brandes, dated Breslaw, December 1, 1816, copied from Gilbert's Annals into the Bibliotheque Universelle, and translated from thence for the Journal of Science, has been carried into execution, but it will be apparent that it might be applied with advantage to our own country.

"Some investigations which I had proposed to attach to this letter, have not afforded the results I expected from them. I had collected from different journals a number of notes on the very remarkable meteorological phenomena of the last summer, and hoped to be able to draw from them some conclusions in regard to the general progress of the season. But on comparing them, I find the inferences I expected to make are not quite certain. It is however worthy of particular remark, that the month of July was, not only in Germany and France but as far south as Naples, rainy, changeable and cold; whilst in Russia, Norway, part of Sweden and the North Sea, it was dry and warm. In America, it must have been cold in the northern part of the United States and hot at the south. These however are only some general conclusions, to be drawn from the comparisons just mentioned.

"If it were possible to collect meteorological statements somewhat more exact, (were it only for the continent of Europe,) it is probable that very interesting consequences might be deduced from them. If we could, for example, color maps of Europe for each of the three hundred and sixty five days of the year, according to the aspect of the heavens on each day, we should discover at a glance, the boundaries of a great stormy cloud which covered Germany and France during the whole of the month of July. We should see whether the limits of this cloud were extended gradually towards the north, or whether new clouds were formed suddenly in the different latitudes and longitudes, and whether whole kingdoms were covered by them.

"Whatever absurdity some persons may find in the idea of these colored maps, representing the atmospherical changes, I believe nevertheless that it is worthy of being carried into execution. It is at least certain that three hundred and sixty five small maps of Europe, colored to represent in one place a blue sky, in another clouds, whether light, or massy, or rain, with little arrows at each place of observation to denote the direction of the wind, if we were to connect with them some definite indications of the temperature, would communicate more pleasure and instruction than the most extensive meteorological tables.

"For making a trial in accordance with these ideas, it would be necessary to procure the observations of fifty or sixty different stations, scattered over the region between the Pyrenees and the Ural Mountains. Although this distribution would leave many points undetermined, we should nevertheless obtain something altogether new. If you could contribute something towards furnishing me with registers of observations after this plan, I would willingly take upon myself the task of comparing, with this object in view, the meteorological tables of any one year. I should not propose to myself to furnish the public with particular and detailed remarks upon all the observations, but simply to give an account of whatever interesting facts were to be discovered in my three hundred and sixty five particular maps. I fear that these ideas, which will perhaps appear to have been made somewhat at a hazard, would not be found easy of execution. Whilst waiting however for some result of this sort, I am about to collect a number of papers on the subject of meteorology, which I hope to be able to arrange and publish in the course of the ensuing year. Along with some fragments of my own, I propose to give a translation, with notes, of an English work, entitled Researches on Atmospheric Phenomena, by Thomas Forster."

It would be difficult in this country to secure the cooperation of as large a number of observers, as were required by Professor Brandes for carrying his plans into execution. But the comparison of a much smaller number of meteorological registers, exhibiting the course of the winds, the aspect of the heavens, and the quantity of rain or snow, would afford valuable information, especially respecting the more remarkable phenomena. Such a comparison would have shown, during the last fall, that violent north east storms may sweep over the northern and eastern states, without making themselves felt at all in the Carolinas. We meet from time to time, in this Journal and elsewhere, with enquiries respecting the "Indian summer"—or the dry fog that covers this country in autumn, and sometimes in the spring. A very few observations in remote parts of the United States, continued through a single year, would be worth more than a considerable book of speculations upon the subject. They would determine in particular whether the opinion of some philosophers who represent it as a smoke proceeding from the combustion of the prairies and forests is correct, or whether, as is more probable, it depends upon some condition of the atmosphere that is not understood, and is similar to that which accompanies the Harmattan on the coast of Guinea. The following quotations have reference to this subject.

"During several of the summer months of the year 1783, when the effects of the sun's rays to heat the earth in these northern regions should have been the greatest, there existed a constant fog over all Europe and great part of North America. This fog was of a permanent nature; it was dry, and the rays of the sun seemed to have little effect towards dissipating it, as they easily do a moist fog arising from water. They were indeed rendered so faint in passing through it, that when collected in the focus of a burning glass they would scarce kindle brown paper. Of course their summer effect in heating the earth was exceedingly diminished. Hence the surface was easily frozen, and the first snows remained on it unmelted and received continual additions. Hence perhaps the winter of 1783–4 was more severe than any that had happened for many years. The cause of this universal fog is not yet ascertained."*

"In my descent from Pittsburg to Louisville, I found the wind, excepting about two days, constantly blowing up the river. The north west or south west winds in fact continue almost three quarters of the year. The deep valley which the river has excavated forms a vortex, into which the rarefied air of the land rushes for equilibrium. The south west wind is uniformly, at this season of the year, (latter part of November,) attended with a dense and bluish atmosphere, charged with vapors, which appear like smoke and sometimes accumulate so as to obscure the land."

"Among the more remarkable features of the autumnal season in this country, (Arkansaw,) is the aspect of the atmosphere, which in all directions appears so filled with smoke as often to render an object obscure at the distance of one hundred yards. The south west winds at this season are often remarkably hazy, but here the effect is greatly augmented by the burning of the surrounding prairies."†

See Dobson on the Harmattan, in the Philosophical Transactions for 1781.—"An extremely dry wind in Africa, coming from the north east, drying even potash. *It generally brings a fog of some unknown nature.*"‡ Humboldt promised a discussion of the subject of dry fogs in the Personal Narrative, but it is to be expected of a book a quarter of a century in publication that some things promised in it will be forgotten and omitted.

It is very desirable to have the atmospherical changes on the eastern and western sides of the Alleghanies connected and compared, by means of a series of good observations; but in the case of the winds, the fact noticed by Mr. Nuttall must be attended to—that the winds along the beds of large streams, or in the neighborhood of the sea, determine nothing precisely in regard to the direction of the main currents of the great aerial ocean.

University of North Carolina, June 7, 1831.

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* Franklin's Works, Vol. III, p. 288.

† Nuttall's Travels, pages 35 and 217.

‡ Young's Philosophy, Vol. II, p. 458.

Art. XXII.—*Report* of Messrs.* Cooper, J. A. Smith, *and* De Kay, *to the Lyceum of Natural History, on a collection of Fossil bones, disinterred at Big Bone Lick, Kentucky, in September,* 1830, *and recently brought to New York.*

Read May 30, 1831.

The Committee beg leave respectfully to report, that these bones having been landed only within a few days, sufficient time has not been afforded them for the accurate determination of every imperfect or mutilated fragment. The greater part, however, belonging to well known animals, were immediately recognized, and it is not believed that any thing of much importance will be hereafter observed. They therefore submit, this evening, a general account of this collection, reserving for a future occasion such further particulars as may be deemed of sufficient interest.

The remains of the Great Mastodon compose more than one half the entire quantity of which this collection consists. Among them is a head, which, though not entire, is in better preservation than any of this animal heretofore discovered. It enables us to form a better idea of the figure of this important part, than could hitherto be obtained. It is found to have the cranium much depressed, in which it deviates remarkably from the Elephant. Both the tusks are preserved, one having been found still in the socket, and the other lying at a short distance off.

Of other large tusks, there are besides, five that measure from six and a half to twelve feet in length, and many more large fragments of others.

Six portions of upper jaws, all containing teeth.

Fifteen portions of lower jaws, twelve of which contain from one to three grinders each.

Besides these, there are seventy three detached molar teeth of all sizes, some of them as large as any yet discovered.

Of the large bones of the anterior extremity, there are five scapulæ, seven humeri, three ulnæ, and one radius, more or less perfect.

Of the posterior extremity, six ossa innominata, ten femora, and five tibiæ. Some of these are almost entire, others are much mutilated.

It is necessary to observe, that although these large bones, as well as the detached tusks, have been provisionally referred to the Mastodon, yet it is not improbable that on a further comparison a part

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* Inserted in this Journal by permission of the Lyceum.

may be found to belong to the Fossil Elephant. The mutilated condition of some renders it extremely difficult to pronounce with certainty upon a slight examination.

The remains of the fossil Elephant comprised in this Collection, are next in interest and number to those of the Mastodon.

The first that we shall notice is a head of a young individual, more complete than any known to your committee, to have been obtained in North America. It consists of the upper and lower maxillary bones, with six molar teeth in good preservation. Isolated grinders have been discovered in the United States in numerous instances, but generally without any portion of bone adhering to them. There are also of the Elephant, in this collection, several other large fragments of jaws, and twenty separate molar teeth.

Of the Horse, there are perfect teeth, and other portions, found under circumstances that favor the belief of their being of equal antiquity with the extinct animals whose remains are associated with them in the Collection. The teeth are remarkably large and sound.

Of Ruminating animals, there are skulls and some other parts of the Buffalo, *Bos Americanus*; of the extinct species named by Dr. Harlan, *Bos bombifrons*, and of a large species of *Cervus*, resembling *C. Alces*.

Finally, we have also discovered among these interesting relics some considerable portions of the *Megalonyx*, whose osteology is still so imperfectly known. The most important of these is a right lower maxillary bone, with four teeth in the sockets, and another detached tooth which appears to have come from the upper jaw. There is also the tibia of the right leg, and perhaps some other bones which may prove to belong to the same animal.

Remarks by the Editor.—Having (since the above account was received) seen the collection of bones so accurately described above, I cannot refrain from attempting to convey to others something of the impression made upon my own mind on entering the room containing this astonishing assemblage of bones, many of which are of gigantic size. They produce in the beholder the strongest conviction that races of animals formerly existed on this continent, not only of vast magnitude, but which must also have been very numerous; and the Mastodon, at least, ranged in herds, over probably the entire American continents.

It is stated by the person who exhibits this collection, that the skull, and the tusks which it contains, weigh upwards of five hundred pounds; that a pair of tusks now lying in the room, and supposed to belong to the same species, weighed six hundred pounds when taken from the ground; and these are nearly perfect, and when we regard them as being merely appendages, and sustained by the animal at a great mechanical disadvantage, since they do not, like horns, rest upon the head, but project from it laterally forward, we can easily imagine that it would require the most powerful muscles to sustain and wield the entire cranium tusks, muscles and integuments.

We shall be happy to see additional illustrations from the able committee to whom we are indebted for the previous statement of facts.

We will however venture to mention the extraordinary curvature of the tusks: those of the elephant, we believe, are always in the form of a bent bow, but these have almost the shape of a sickle, with the blade curved to one side; they are sharp and pointed. Many of the molar teeth of the mastodon in this collection, as we have often observed elsewhere, are much worn by grinding, and possess a high lustre from the polish produced by friction; they appear to have belonged to animals of very various ages, and the smaller teeth are generally little or not at all worn; in some of the teeth, the processes or ridges which are so remarkably prominent in the mastodon and so remarkably contrasted also in this respect with those of the elephant, are entirely worn away, and are replaced by a deep, egg shaped cavity, of extreme polish, as if it were varnished.

It is stated that this collection of bones contains upwards of three hundred in number, besides twenty two tusks, and that it weighs in all 5,300 pounds. The bones were obtained by Capt. Finnel, at the Big Bone Lick, twenty miles south of Cincinnati, in Kentucky. The deposit was twenty two feet below the surface, but bones appear to have been found at various depths, as may be observed in the notice of the Rev. Sayres Gazley,* Vol. XVIII, p. 137, of this Journal.†

The discovery of bones of the horse is very extraordinary, as this animal had been supposed not to be a native of America, and the Committee believe that they are of equal antiquity with the other bones; the great size of the teeth implies very large individuals, if not a large species, in analogy with similar facts on the eastern continent.

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* Then anonymous, but since acknowledged by the Rev. gentleman, who visited the spot.

† This collection is at present shewn at the corner of Broadway and Pearl street, New York, but it is understood that it will ere long, be transferred to London or Paris.

Art. XXIII.—*Reply to Dr. Christie on Hail Storms; by* Denison Olmsted, Professor of Mathematics and Natural Philosophy in Yale College.

To the Editor of the American Journal of Science.

Dear Sir,—In the *New Edinburgh Philosophical Journal,** is an article on "Indian Hail Storms," communicated to that Journal by *A. Turnbull Christie,* M. D. The writer mentions several facts relative to the occurrence of hailstorms in the southern parts of India, and of course within the limits of the torrid zone, which facts appear to him inconsistent with the views I had offered respecting the causes of hailstorms, in an article first published in the eighteenth volume of this Journal, and republished in the New Edinburgh Philosophical Journal.

These facts are of so interesting a nature, that I could not wish them to be witheld from your readers, although they should subvert the explanation I had ventured to suggest; but whether they subvert or confirm that explanation, your readers will have an opportunity of judging, if they will do me the favor, after reading the annexed article, to peruse the subjoined remarks. The article is as follows.

[From the New Edinburgh Philosophical Journal.]

On Indian Hailstorms; by A. Turnbull Christie, M. D.

In the last number of your Journal a new theory of hailstorms is proposed by Professor Olmsted of Yale College, viz. that they are caused by "the congelation of the watery vapor of a body of warm and humid air, by its suddenly mixing with an exceedingly cold wind in the higher regions of the atmosphere."

According to this theory it is very easy to account for those hailstorms which so frequently occur in some parts of the temperate zones, as in the south of France, or in the United States of America; for in such situations it is very possible that an intensely cold wind, proceeding from the north at a great height, might meet with a warm body of air highly charged with moisture, and thus cause a very sudden congelation, with the other phenomena that generally accompany such storms. But this explanation could not apply (even according to the Professor's own showing) to hailstorms in the torrid zone, for any two currents of air, within this zone, would differ so little in tem-

* This number of that work not having yet reached us, the above extract is taken from the Philadelphia National Gazette, of June 14.

perature, that their sudden mixture could not possibly produce congelation, but merely clouds and rain, thunder and lightning; and, says the Professor, "in this region we know not where to look for the freezing current, unless we ascend so high that there no hot air exists holding watery vapor to be frozen by it." He therefore supposes that violent hailstorms are unknown in the torrid zone, excepting in one situation, viz. in the vicinity of lofty mountains covered with snow. Here, however, he is mistaken, hailstorms being by no means uncommon in different parts of the peninsula of India, and consequently at a distance of many hundred miles from any lofty mountains.*

We are told, in Rees' Cyclopedia, that hailstorms never occur in the torrid zone; and in the Edinburgh Encyclopædia, under the article Physical Geography, that they never occur there, except at an elevation of not less than one thousand five hundred or two thousand feet. This, I will show, is by no means the case. In May 1823, a violent hailstorm occurred at Hydrabad, which is about 17 degrees north latitude, and has an elevation (I believe) of not more than one thousand feet above the level of the sea. The hailstones were of a considerable size, and a sufficient quantity was collected by the servants of a military mess to cool the wine for several days. A hailstorm occurred at Darwar, north latitude 16° 28′, east longitude 75° 11′, in May or June 1825. The height of Darwar above the level of the sea is two thousand four hundred feet, but it is near no high range of mountains. The hailstones had a white porous nucleus, and varied in size from that of a filbert to that of a pigeon's egg. A similar storm occurred at the same place, and about the same season, in 1826. These are the only instances of hailstorms which came under my own observation during the five years I was in India; but numerous others might be brought forward from the testimony of others. I shall only mention a few. Lieutenant Colonel Bowler, of the Madras army, tells me that he witnessed a violent storm of hail at Trichinopoly, about the middle of the year 1805, when the hail stones were nearly as large as walnuts. He also mentions a very violent hailstorm which occurred in Goomsa Valley, about twenty five miles west of Gamjam, and only a few feet above the level of the sea, when he was in camp there about the end of April 1817. It commenced about half past three in the afternoon. The weather had previously been very sultry, with hot blasts of wind, and heavy clouds, which appeared almost to touch

* The highest mountains in the peninsula of India are the Neelgherries, a small group, situated between the tenth and eleventh degrees of north latitude, and having a height of little more than eight thousand feet above the level of the sea, being not more than one half of that which the snow line would have in this situation.

the tops of the tents. On the hail falling, the air became on a sudden disagreeably cold, as it had been before oppressively hot. The same gentleman also witnessed a hailstorm at Masalapatam, on the coast of Coromandel, in 1822 (he thinks in the month of April); and others, at different times, in various parts of India.

We are told by Heyne, in his historical and statistical tracts on India, that "masses of hail of immense size are said to have fallen from the clouds, at different periods," in the Mysore country; and that "in the latter part of Tippoo Sultan's reign, it is on record, and well authenticated, that a piece fell near Seringapatam of the size of an elephant." Of course, it is not to be expected that we are to believe this to the letter—we must make some allowance for oriental exaggeration.

It is needless to multiply examples, for I believe there is not an officer who has been many years in India, who cannot bear testimony to the frequency of hailstorms in that country. Professor Olmsted's theory, therefore, even according to his own account of it, must be abandoned; or, at all events, it will only apply to those falls of hail which occur in the temperate zones.

Remarks.—That these facts are not inconsistent with my "theory of hailstorms" will, I think, appear evident, by placing side by side my leading proposition, and one of the most striking facts the Doctor has mentioned.

Proposition.	*Fact mentioned by Dr. C.*
Hailstorms are caused by the congelation of the watery vapor of *a body of warm and humid air*, by its suddenly mixing with *an exceedingly cold wind*, in the higher regions of the atmosphere.	The weather [previous to a violent hailstorm] had been very sultry, with *hot blasts of wind*, and heavy clouds, which appeared almost to touch the tops of the tents. On the hail falling, the air became on a sudden, as *disagreeably cold*, as it had been before *oppressively hot*.

This fact is so much to my purpose, that had I met with it in season, I should undoubtedly have annexed it to those offered in support of my views. The hot sultry blasts that preceded, and the cold weather that followed the storm, implies the meeting of just such elements as the theory demands. It has been suggested, indeed, that the cold that ensues is caused by the hail itself; but this does not account, like the other supposition, for the formation of the hail, and moreover there is usually, if not always, *a change of direction* in the wind; that is, the wind blows from a different quarter after the storm, and is often exceedingly cold when the quantity of hail that falls is too small to produce so great a change.

Dr. Christie is under a mistake in supposing that my explanation of the causes of hailstorms, requires that these storms should never occur in the torrid zone, except in the region of high mountains. So far from this, the theory demands that hailstorms should occur *wherever* such hot and cold blasts of air, as he mentions, meet and mix together. For obvious reasons assigned in my paper, they do not *often* meet in the torrid zone, and accordingly hailstorms are much less frequent there than in the temperate zones. The two very respectable authorities which I quoted,* inform us, the one that they never occur in the torrid zone, and the other that they are never met with, except at an elevation of one thousand five hundred or two thousand feet. It appears, however, from the facts adduced in the foregoing article, that there are other situations within the torrid zone where hailstorms occur; but still, so far as we can gather the circumstances from the brief statements of Dr. Christie, these storms result from the same causes as were assigned for hailstorms in general, namely, *from the sudden meeting of blasts of very hot and very cold air.*

I beg leave to add one remark more. Although I have endeavored to show *the precise manner* in which these hot and cold blasts meet, and hence, as I suppose, furnished a probable explanation of the extraordinary fact, of the much greater frequency of hailstorms in the temperate, than in the torrid or the frigid zone, yet should these blasts meet in any other manner,—should cold and hot portions of air meet either by the *subsiding* of cold strata from above, as maintained by Professor Mitchell,† or should the opposite kinds of winds be mixed together in the form of whirlwinds, as maintained by Mr. Redfield,‡ the leading doctrine which I have advanced would still be true, that hailstorms result from the mixture of blasts of hot and cold air, and not from any agencies of *electricity*, to which they have been more commonly ascribed.

Respectfully and truly yours,

DENISON OLMSTED.

Yale College, June 17, 1831.

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* Rees' Cyclopædia, and the Edinburgh Encyclopædia.

† Amer. Jour. Vol. XIX. ‡ Ibid.

MISCELLANIES.

(FOREIGN AND DOMESTIC.)

Extracts and translations by Prof. GRISCOM.

NATURAL HISTORY.

1. The *Planera*, formerly called the *Siberian Elm*, is a tree which grows on the borders of the Caspian and of the Black Sea. According to an account given of it to the French Academy on the 31st of January, last, by *Desfontaines* and *Mirbel*, it grows to the height of twenty-five or thirty metres, with a straight and well proportioned trunk, free from branches, to the height of eight or nine metres, and of three or four metres or more in circumference. Its head is large, and tufted, and the branches rise almost perpendicularly. The sap of the *Planera* is white, but acquires a red color toward the heart. It is heavier and stronger than the elm or chesnut, and of so close a texture as to receive a beautiful polish. The wood is so hard that it is difficult to drive a nail into it. It has the suppleness and elasticity of oak, and is preferred to that wood for planks and carpentry in Georgia. It is not subject to worms, and is very durable in water and in the ground. Being larger than the forest trees of France, it offers many advantages, and is deemed well worthy of cultivation. Its foliage is never injured by caterpillars.—*Rev. Ency. Jan.* 1831.

2. *Change of climate; diminution of temperature on the surface of the earth.*—It is not only from analogy, observes Mr. Lyell in his new work on geology, that we must infer a diminution of temperature in the climate of Europe; there are proofs of this doctrine in the only countries hitherto studied by geologists, in which we might expect to find direct proofs. It is not in England, or in the north of France, but on the borders of the Mediterranean, from the south of Spain to Calabria, and in the islands of the same sea, that we must look for conclusive demonstrations of this fact. For it is not only in beds whose fossil shells are like the shells of living species, that a theory of climate can be subjected to a kind of *experimentum crucis.* In Sicily, at Ischia and in Calabria, where fossil shells of the most recent beds belong almost entirely to kinds which are known to be

still inhabitants of the Mediterranean. The conchologist remarks that individuals deposited in the interior of the earth, surpass, in medium and size, their living types. It cannot however be doubted, notwithstanding such a difference in dimensions, that the species are identical, since the living individuals, sometimes, though rarely, attain to the size of the fossil; and the preservation of the latter is so perfect that they still retain their color, which furnishes another means of comparison.

In leaving the sea and advancing into regions less disturbed by modern volcanos, there are found in the Sub-Appenine hills some species still living in the Mediterranean, mingled with multitudes of other kinds now extinct, and which present indubitable indications of a warmer climate. Several kinds are common to the Sub-Appenine hills, the Mediterranean, and the Indian Ocean. The fossils correspond in size with their fellows within the tropics, while the individuals of the same species now in the Mediterranean, are small, degenerated and stunted by the absence of those conditions which they still enjoy in the Indian seas.

No observations of a contrary nature have occurred to neutralize our conclusions, neither are there found associated in these groups, individuals appertaining to species confined within the arctic regions. On the contrary when we can identify these fossil shells with living species foreign to the Mediterranean, it is not in the icy sea, but between the tropics that we must look for them.

Mr. Lyell has carefully examined several hundred species of shells obtained in Sicily at the height of one thousand feet, among which is a great number of kinds still living in the Mediterranean; the difference of size being very striking in the greater number of these two classes.

Some interesting observations, formerly made by Péron and Lesueur, stated in the Annales du Museum, T. XV, p. 287, and which Mr. Lyell has not cited, confirm his opinion that the greater size of individual shells of the same species, is an indication of a change of climate. These naturalists have remarked that every species of marine animals has received a distinct location, confined to certain parts of the ocean, and that in those positions they are found to be larger, and more beautiful. In proportion as they are removed from this locality, they degenerate, and are at length extinct.

The *Haliotes gigantea* for example, which in Van Dieman's land, attains the length of fifteen to twenty centimetres, suffers in its dimensions at Maria Island, is still more degraded at the Island of Decres and Josephine, is only a miserable abortion on the rocks of Nuytland, and is no longer visible at port King George. The same thing is observable in the *Phasianellus;* their proper habitation is at Maria island where vessels are loaded with them; and after suffering insensible degradations they are lost at port King George. It is interesting to witness the same phenomena exhibited in a horizontal direction on the present surface of the earth, appearing again in a vertical direction upon the different surfaces, which, at successive periods have limited the exterior configurations of the terrestrial globe.—*Bib. Univ. Dec.* 1830.

3. *Monography of the genus Cypræa.*—Duméril and De Blainville made a report to the Academy on the 27th of December, on the memoir of M. Duclos, entitled *Monographie du genre Cypræa,* (vulgairement *coquilles porcelaines.*) This kind of shells is one of those for which amateurs have still a predilection, not only on account of the elegant and singular form of the shell, but especially from the beauty of their robes, the almost infinite variety of the colors with which they are ornamented, and of the splendid kind of varnish with which they are covered. It is in this genus therefore, as well as the cones and volutes, that are included those species which have retained the greatest venal value. It is time that this genus, which has long been only an object of luxury and curiosity, should rise to a level with the other departments of *conchology.* This was not an easy thing, on account of the connection between the animal and its shell, and of the peculiar developement of the lobes of its mantle, which, void in its earliest period, acquires a successive developement, so as to cover the entire shell when the animal is at rest. The shell passes through three or four distinct stages, which are very different in form, and especially so in structure, thickness and color. Several naturalists, with a view to an explanation of the fact, that in the same species there are found both dwarfs and giants, have thought it sufficient to state that the animal changed its shell, an opinion which appears to the reporters to have been victoriously refuted. The labors of *Lamarck, de Blainville,* and of *Gray,* adjunct curator of the British Museum, have still left much to be desired. M. Duclos has been perseveringly engaged for fifteen years in the monography of the genus *Cypræa.* During his travels in Belgium, Holland and England, he has acquired new ma-

terials and perfected what he had before learned. He has been at great pains and expense in procuring the three or four varieties of the developement of each species, from its issue from the egg to its state of decrepitude, as well as those on which may depend the proportionate size and the color. From these labors has resulted the finest collection with which we are acquainted. Those species which are wanting, are supplied by good colored figures. Aided by these materials, M. Duclos has executed a complete and methodical description, with a colored representation of all the species and principal varieties of the porcellanous shells now existing in the collections of central Europe. He has considerably increased the number of known species, especially in France, since he extends the whole number of species to one hundred and forty two, of which seventy seven are from New Guinea, California, Scychelles, &c. Lastly, he has distributed them into three very natural sections; the Alucitated or sleek kinds, the tuberculated and the striated. We hope that this great work may be connected with the materials which Quoy and Gainard have collected by their late circumnavigation, and which have brought to our knowledge a great number of species. The reporters conclude with the hope that Duclos may, as soon as possible, be enabled to gratify the taste of amateurs by laying before them the result of his extensive and expensive labors, which they deem to be altogether worthy of the encouragement and approbation of the Academy.—*Rev. Encyc. Dec.* 1830.

4. *Bone Caves in New Holland.*—A collection of fossil bones has been sent to Prof. Jameson, from New Holland, taken from a cave or caves in Wellington Valley, about 210 miles west from Sidney. They are found embedded in a red ochreous cement which occurs partially in crevices of the limestone rock, in different parts of the interior of South Wales. The limestone rests on granite, and generally near or under trap rock. The bones are found in a broken state, as in caves of a similar character in Europe, and like them they are of animals of very different kinds and sizes.

It appears from the description, by Major Imrie, of the red ochreous cement, containing bones which occur at Gibraltar, and along the northern shore of the Mediterranean, that this breccia is of the same kind, both *in situ*, and character, and that its antiquity is at least equal to, if not much higher, than that of the bones found under stalagnite, in caves in different parts of Europe.

The Australian bones have been examined by Prof. Jameson, by Dr. Adam, and especially by W. Clift, an experienced and distinguished anatomist of the College of Surgeons, London. One of them approaches very nearly in form to the metacarpal bone of an ox, but much larger. It also bears a great resemblance to the radius of the Hippopotamus. The others are mostly bones of the Dasyurus, Wombat, and Kangaroo.

From the geological characters of the caves, and bone-breccia, the mode of distribution of the bones in the caves, and the nature of the teeth and bones themselves, it follows—

1. That these caves agree in character with those in Europe.

2. That the bone-breccia exhibits the same character as the varieties of that rock found in different parts of the European continent and islands.

3. That New Holland was, at a former period, distinguished from the other parts of the world, by the same peculiarities in the organization of its animals, which so strikingly characterize it at the present day.

4. That the large bone resembling the radial bone of the hippopotamus, shews that Australia formerly possessed animals much larger than any of the present existing species, equalling, or even exceeding in magnitude the hippopotamus; a fact of high importance, when we recollect that the quadruped population of New Holland is at present but meagre, the largest species being the kangaroo.

5. That the bone caves, and bone-breccia, contain, along with animals at present known, others that appear to be extinct, as is the case with the caves and breccia of Europe.

6. That the same agent or agents that brought together the remains of animals met with in bone-caves and bone-breccia, in Europe, operated on New Holland.

7. Lastly, that the animals in the Australian caves and breccia were destroyed and became fossil, if not at the same precise time as the European, during a similar series of Geological changes.—*Edin. Phil. Jour. Mar.* 1831.

5. *Volcano in New Zealand.*—Accompanying a specimen of volcanic ashes, sent to Professor Jameson, by Col. Lindsay of Sydney, is a notice to the following effect: This substance is found on what is called *White Island*, from the ashes that continually fall from a volcano, at present in a state of activity, and which has been long

in the same condition. It is about three miles round, and lies opposite to the Bay of Plenty, between the river Thames, and the East Cape, and from twenty to thirty miles from the main land of New Zealand. When this island was last visited, it presented a frightful display of flame and smoke, from the crater of its volcano. At the foot of the pile in which the volcano is situated, there is a lake of *boiling sulphur*, and all around the lake the ground is encrusted with sulphur. The natives say the volcano runs under the sea, and bursts out again in the interior of New Zealand, about 20 miles from the shore, in a district where there is a large hot lake, in the waters of which, the natives cook their provisions.—*Ibid.*

6. *Interesting discovery of Fossil Animals.*—There has been lately sent to the Garden of plants, a collection of fossil bones, from the Lacustrine deposits of Argenton, (Indri,) consisting of five or six species of Lophiodon, from the size of a large Rabbit, to that of a horse; also species of the genus Anthrocotherium, of the Trionyx and Crocodile. Some recent discoveries in the diluvian ossiferous deposits of Chiveley, (Loiret,) of the bones of the extremities of the animal called Gigantic Tapir, by Cuvier, shews that this animal, by the test of its osteology, is closely allied to the living Tapir, although equalling, if not exceeding the Rhinoceros. The Indri and Loiret are two departments in the central districts of France.—*Ibid.*

7. *Recent formation of Zeolite.*—Stilbite, Mesotype, and Apophyllite, appear almost always as a newer formation in the cavities of Amygdaloid, and along with these is found calcareous spar. The formation of zeolite through the action of atmospheric water on dolerite, seems still to be going on. We observe it forming in hollows of a conglomerate, in which zeolite plays the part of calcareous sinter. Springs deposit a similar zeolite sinter; and when, in the summer the brooks dry up, their whole bed appears white. In deep caves, where, during lower temperature and greater humidity of the air, scarcely any evaporation takes place, I found a matter partly gelatinous, partly crystalline, which proved the continued production of zeolite.—*Forchammer.*—*Ibid.*

8. *Crystals in Living Vegetables.*—Various naturalists have taken notice of the appearance of crystals in the internal parts of vegetable tissues, but nothing very explicit and certain has been stated respect-

ing them. M. Turpen has discovered, in the cellular tissue of an old trunk of the Cereus Peruvianus, in the Garden of Plants of Paris, where it has been growing one hundred and thirty years, an immense quantity of agglomerations of oxalate of lime. They are found in the cellular tissue of the pith and bark. They are white, transparent, foursided prisms, with pyramidal terminations, collected in radiant groups.

CHEMISTRY.

1. *On the development of Azotic gas in Warm Springs*, by C. Daubeny, M. D. F. R. S. Prof. of Chemistry in the University of Oxford.—In a memoir read by Prof. Daubeny, on the 30th Nov. 1830, before the Natural History Society of Geneva, of which he is an honorary member, he adduces the fact of the disengagement of azotic gas from thermal springs, as tending to support the theory of volcanic action to which he gave the preference in his work on volcanoes, published in 1820. This is the theory of Sir Humphry Davy, which ascribes volcanic force to the disengagement of vapors, consequent upon the infiltration of water, through the crust of the earth upon the metallic bases of the alkalies and earths.

A more simple view of the causes of this phenomena, arises from the belief now entertained, that the interior of the earth is in a state of incandescence, and that the contact of water with this ignited mass, whatever may be its nature, must necessarily occasion concussive or explosive forces.

Prof. Daubeny has examined various hot springs in the region of the Alps, and he cites the authority of other good chemists to prove that those of the Pyrenees, as well as the thermal waters of some other countries, discharge azotic gas, mixed in some cases with carbonic acid, and occasionally a small quantity of oxygen.

This copious discharge of azote he considers as the result of that chemical action in the interior of the globe, which gives rise to the increased temperature of these waters.

The entire nature of these changes, is undoubtedly covered with an impenetrable veil, but the author thinks that the disengagement of azote cannot be referred to the single access of water to any incandescent substance,—but that it would be the consequence of a combustion, which, though proceeding from the infiltration of water, may be maintained by means of atmospheric air.—*Bib. Univ. Dec.* 1830.

2. *Salicine.*—On the 6th of December last, Gay-Lussac presented to the French Academy of Sciences, six bottles of Salicine, sent to him by M. Leroux, and destined for the six members of the Section of Medicine. This interesting substance is manufactured by M. Leroux, in large quantity, and it is his wish that its qualities as a febrifuge may be thoroughly tried.—*Rev. Encyc. Dec.* 1830.

3. *Crystalline compounds in Sulphuric Acid.*—Chevreul and Serullas made a report to the Academy on the 27th of December, on the memoirs of *Gaultier de Claubry*, relative to the crystalline compound which is formed in the preparation of sulphuric acid. "According to Gaultier, the theory of the formation of sulphuric acid requires some modifications. In his view, the sulphurous acid completely decomposes a portion of hypo-nitric acid, by disengaging azote: the sulphurous acid, transformed into sulphuric acid, unites with the nitrous acid and water, to form, as is well known, crystalline matter, which being dissolved in water, is converted into sulphuric acid, hypo-nitrous acid, and deutoxide of azote. This crystalline compound includes less water than the hydrate of sulphuric acid, and the denomination of nitrous and hydric sulphate, which Berzelius has given to it, ought to be adopted, as denoting exactly its composition. The numerous experiments of Gaultier require the use of materials difficult to manage, and they can be performed only by dextrous hands. They confirm known principles,—they show a disengagement of azote before unobserved, and lead to some changes in the analysis of crystalline matter.—*Ibid.*

4. *A remarkable Chalybeate Water* discovered in the course of the last summer, at Vicars Bridge, near Dollar, in Scotland, is described by Arthur Connel, F. R. S. E. in Jameson's Journal. Its sp. gr. is 1.04893. Three cubic inches of it weighing about 814 grs., contain 42.651 grs. or more than 5 per cent of solid matter. Sea water contains about 3 per cent. of saline constituents. The contents of one gallon of the water are—

Per-sulphate and proto sulphate of Iron,	3037.84
Sulphate of alumina,	580.64
Sulphate of magnesia,	277.20
Sulphate of Lime,	43.68
Common salt and muriate of potash,	2.04
	3941.40

The quantity of iron in this water is so great, as to produce, by the addition of nut galls, and a little gum arabic, a pretty good writing ink. The water is supposed to proceed from the decomposition of shale in its vicinity.—*Edin. Phil. Jour. Apr.* 1831.

5. *Platina Lamp.*—In a communication from George Merryweather, Esq. to Professor Jameson, dated Edinburgh March 5th, 1831, it is proposed to extend the aphlogistic platina lamp, by constructing the body of the lamp, of tin large enough to contain a quart or more of alcohol. This will be sufficient to keep the platina in a state of constant ignition for thirteen or fourteen days and nights. Such a lamp, while it is entirely devoid of glare, affords sufficient light to shew the face of a watch in the dark of night. It is best managed by inserting a little spongy platina into a small cage of platina wire. The top of the lamp wick should be spread out, a little, in the form of a coronet, and the wire cage pricked into it, so as to be nearly, but not quite, in contact with it. The bottom of the lamp should be concave so that the wick may take up all the alcohol, and if it be connected with an unfailing reservoir of alcohol, the lamp may be kept ignited for years. The spongy platina does not appear to be, in the least, deteriorated by being kept in a state of constant ignition.

To prevent the access of dust, &c. the lamp is covered with a glass, shaped like an inverted funnel, resting upon a ring or cylinder of tin having holes around it to admit a current of air. If a light is required, the glass cover is to be elevated and the platina gently touched with a match of chlorate of potash, which will be instantly inflamed.

Should the lamp diffuse an unpleasant odor in the room, a condensing shade or cover may be applied to it, formed of tin. This cover is conveniently made of a conical shape. The base of the cone is to be convex inward, like the bottom of a common glass bottle. From the center of this concave bottom (concave externally) a tube proceeds downwards, of sufficient length and diameter to admit the neck of the glass funnel which covers the lamp. The vapors that rise up through the funnel into the conical condenser, and fall to the bottom of it in a liquid state, may be drawn off through a stop cock soldered to the edge of the cone. This cone may be suspended by a ring to a nail in the wall, and brought over the glass funnel when required.

The author finds that equal parts of alcohol and whiskey answer quite as well as pure alcohol, or he says, one third of alcohol and two thirds of whiskey do very well. This lamp may prove very useful in mining districts, as a constant light that may be depended upon, if the reservoir is periodically replenished.—*Ibid.*

6. *A new metal discovered.*—M. Dulong read, on the 7th of February last, to the French Institute, a letter from Berzelius, which announces the discovery of a new, simple substance by Mr. Sestrom, director of the mines of Fahlun in Dalecarlia. Mr. Sestrom being engaged in examining an iron, remarkable for its softness, discovered in it a substance, which appeared to him to be new, but in such small quantity, that he could not determine with accuracy all its properties. Afterwards, however, he found it more abundantly in the scoriæ of the iron, and was thus enabled to prove that the substance in question was a new metal, to which he gave the name of *Vanadium*, after an ancient Scandinavian deity. We have had communicated to us the following additional notice. Humboldt presented to the Institute specimens of vanadium, the new metal recently discovered in the iron of Esterholm by Mr. Sestrom, and which also exists in Mexico, in a brown ore of lead of Zimapan. M. Del Rio, Professor in the school of Mines, of Mexico, had extracted from that ore a substance, which, to his apprehension, resembled a new metal, to which he gave the name of *Erythronium*. M. Collet Descotils, to whom he sent a specimen, could not admit that erythronium is a single substance, and believed he had demonstrated that it was an impure chrome. It would appear that Prof. Del Rio agreed in this opinion, and there was no longer any idea of its being a new metal. But since the discovery of Seström was known to Voller, he, struck with the resemblances which exist between the properties of Vanadium and that which the Mexican chemist attributes to his erythronium, has repeated the analysis of the brown ore of lead of Zimapan, and from which he has obtained a simple body perfectly identical with that of the iron ore of d'Esterholm. It is worthy of remark that so rare a metal should have been discovered in two places so far asunder as Scandinavia and Mexico.—*Ibid.*

MEDICAL CHEMISTRY.

1. *Efficacy of Iodine.*—A report was made to the French Academy, on the 3d of January, 1831, by *Duméril* and *Magendie*, on the treatment of scrofulous diseases, by preparations of iodine, at the hospital St. Louis, by M. Lugol. "The Academy has already been informed by the report which we had the honor to make, with what success M. Lugol treats those diseases. This success is such that a

disease, very common among the poor, the treatment of which was so long and so difficult, that it has been rigorously excluded from our hospitals, has become curable in a limited time and by unexpensive means, so that the numerous poor who are attacked with it have now a right to be admitted and treated in the hospitals like other patients. The new facts which your committee have obtained, must produce on this point an entire conviction. The cases exhibited to us were not those of scrofula of the first or second stage, but scrofula of the most inveterate form,—real scrofulous consumptions, as they are called in medicine. Deep alteration of the glands and other organs, actual lesions of the bones and their principal articulations, with those general accompaniments which announce a speedy death, have been, and we assert it, in great numbers, entirely cured in the space of a few months; and, saving the indelible marks which such deep seated diseases cannot fail to leave, these patients enjoy all the health which it is possible for them to obtain. These results are so much the more deserving of attention, and so much the more satisfactory, as the greater number of the patients which M. Lugol has subjected to his treatment, were, before he commenced with them, in a hopeless state, and which had been admitted into his rooms only as deplorable examples of the ravages of an incurable disease. One of your committee is perhaps as favorably situated as possible for appreciating the merits of M. Lugol's clinical researches. A physician in the largest hospital of Paris, of a numerous division filled with organic diseases over which art has no more power, he has continually under his observation, unfortunate beings who with the sinister quality of incurable, come, in the midst of sufferings as difficult to describe as to lessen, to die in the places provided for them. Among the unfortunate beings who are thus destined, are frequently found scrofulous persons, whose mutilations are truly horrible. Before the discovery of iodine, they were all devoted to certain death; but, since the introduction of iodine and bromine into therapeutics, your committee have had the sweet satisfaction of restoring to life, and even to a tolerable existence, many of these incurables; and, what it is not unimportant to add, these cures have been as rapid as unexpected. We shall not here go into the minute facts which M. Lugol has submitted to us. We have added a few of them to this report, but they are not of a nature to be read. Such descriptions would only sadden the feelings, without any advantage to science. M. Lugol, as we have before stated, does not pretend to the discovery of the utility of iodine in scrofulous diseases; but from the great number of cures which he has obtained, from the zeal and perseverance with which he pursues his researches, by the light which he has thrown upon the various effects produced by the different preparations of iodine, employed internally and externally, M. Lugol has effected a decided advancement in medicine, and as he has, besides, had the wisdom to avoid all vague explanations, the least inconvenience of which is that they are useless, we have the honor to propose that the researches of M. Lugol be crowned with your approbation, by engaging him to continue in labors whose results are so advantageous to humanity." (Approved.)—*Rev. Encyc. Jan.* 1831.

STATISTICS.

1. *Universities of Prussia.*—The following table gives the number of students in each of the universities, during the summer session of 1826 compared with that of 1829, and the increase or diminution.

Universities.	No. of students during the summer session of		Difference.	
	1826.	1829.	More.	Less.
Berlin,	1245	1706	461	
Bonn,	526	978	452	
Breslau,	710	1147	437	
Greisswald,	227	159		68
Halle,	1119	1291	172	
Königsberg,	303	405	102	
Munster,		361		
Total,	4130	6047	1624	68

It thus appears that there has been an increase of more than three eighths of the number of students in the six Prussian universities in the course of three years.

Universities of Germany.

Universities.	Number of students during the summer session of		*Difference.*	
	1826.	1829.	*More.*	*Less.*
Friburg	556	627	71	
Giessen	371	558	187	
Göttingen	1.545	1,264		281
Heidelberg	626	602		24
Jena	432	619	187	
Leipsig	1,384	1,400	16	
Marbourg	304	351	47	
Munich	623	1,854	1,231	
Tubingen	827	876	49	
Wurzbourg	660	513		147
Total	7,328	8,664	1,788	452

It results from this enumeration, that the number of students in these ten universities has increased rather more than one fourth. It may therefore be inferred that a proportionate increase has taken place in all the universities of Germany, the foregoing seventeen being justly regarded as an evidence of the general progress. The diminution in the nnmber of students of Greisswald, Göttingen, Heidelberg and Wurzbourg, is attributed to local causes.—*Idem.*

2. *The city of Berlin.*—The history of this city by *W. Mila*, Berlin, 1829, furnishes the following facts relative to its progressive rank and greatness. It was probably founded by Albrecht II, who reigned between 1202 and 1220. In 1640 it contained but 6000 souls; but in 1688 the number of inhabitants had risen to 20,000, and at the beginning of the 18th century the population was 30,000. At the death of Frederick I, in 1713, his capital contained 50,000; in 1741 the number had risen to 90,000, including the military. In 1773, the population was 133,580, and in 1797, it was 183,960, comprehending 45,574 soldiers. At the end of 1827, the number of inhabitants, including 16,909 militaires, was 220,277, distributed among 8511 houses and 5000 back buildings, insured together against fire for 250 millions of francs. The electoral library contained in 1687, 1618 manuscripts and 20,600 volumes. In 1827, it numbered 4611 manuscripts, and 250,000 printed volumes. The extent of the city embraces a circumference of 20,475 paces, and a surface of 973,743 square perches, and within the southern wall of the city a space is left destined for the projected enlargement, in which are laid out thirty one new streets, eleven large public places, and six smaller ones.—*Rev. Ency. Fev.* 1831.

3. *St. Petersburgh Academy of Sciences.*—The annual public session of this Academy was held on the 10th of January, 1831. The Vice President, M. Storch, the celebrated economist, in the chair. M. Fuss, perpetual secretary, read in French a statement of the labors of the Academy during the year 1830. Death had deprived it, within that period, of the following members: M. Mertens, adjunct in zoology; M. Ewers, professor at Dorpat; Soemmering, of Munich; Fourier, of the French Institute; Dr. Munter, bishop of Copenhagen; and Major Rennell, of London. All the museums of the Academy have received considerable accessions. The hall for magnetic observations, commenced in 1829,

has been finished and furnished with instruments, so that this Academy possesses the only establishment of this kind, complete and perfect, and the public may soon be in possession of the results of the labors of M. KUPFER, who is devoted to this branch. Eight similar observatories are to be constructed in different parts of Russia.

The zoological museum has been enriched by LANGSDORF, MERTENS, and especially by KITTLITZ. It contains seven hundred and fifty four specimens of three hundred and fourteen species of birds, mostly new, and a rich collection of shells sent by EGGER from Port au Prince. The herbarium has received an important increase by the collection of plants from India from Dr. WALLICH, director of the garden at Calcutta; by that of FLEISCHER, at Esslingen, and by the remittances of TOURTCHANINOF, from Irkutzk, of HAUPT, from Ecatheriaoslaf, and of KATALSKY, KITTLITZ and EGGER. The mineralogical cabinet is enriched by the rare collection of M. STRUVE, resident Russian minister at the Hanseatic towns, purchased for 50,000 rubles. The Asiatic museum is indebted to M. CANERINE, minister of finance, for a great number of curious medals of Persia and Tartary, as well as a complete collection of Russian medals, struck during the last three reigns, consisting of twenty of gold, seventy eight of silver, and two counters of Bronze. The museum has also received the collection of counterfeit silver medals of M. BECKER, of Offenbach, to the number of two hundred and ninety six, imitating with great fidelity and admirable skill, the antique medals of Greece and Rome. The Egyptian museum has received from Admiral Count HEYDEN, two stones, one of which is sepulchral with hieroglyphic inscriptions, brought from Greece. Agreeably to the proposition of the late M. MERTENS, an ethnographic museum has been founded, and has received the objects collected by M. Mertens during his voyage round the world. Among the number of important acquisitions must be mentioned the port-folio of drawings brought by the expedition of the ships *Moller* and *Séniavine*, and presented to the Academy by the savans and artists who accompanied it. This rich and precious collection is composed of one thousand and twenty eight sheets, the greater portion of which will enrich the account of this voyage which the Academy intends speedily to publish. M. LENZ has presented to the Academy the journal of his travels to Nikolaïef and Bakons. The archeographic labors have been continued under M. STROIEF, who, arrested, in his excursions by cholera morbus, was enabled by this delay to prepare a report which he intended to read at this session, but was prevented by the interruption of communication between Moscow and Petersburgh. The 11th volume of the memoirs of the Academy contains some posthumous dissertations of EULER, who, before his death, manifested the desire that the memoirs of the Academy should contain some of his works during the forty consecutive years after his decease. They have in fact enriched twenty five of its volumes. In 1823 the term of forty years having expired, there remained in the archives of the Academy some fourteen dissertations of the celebrated mathematician, now published in this 11th volume, conjointly with four dissertations of SCHUBERT and thirteen of FUSS. They have continued the printing of the *Species Graminium* of TRINIUS, the work of KREPFER on crystallography, the Mongolian grammar of SCHRINDT, the Russian translation of the calcul differentiel et integral of M. CANCHY, by Bouniakovsky. The number of dissertations and manuscripts read to the Academy in the 40 sessions it held during the year 1830, amounted to 50. After the statement of M. FUSS was gone through, M. HESS read, in French, a dissertation on *Waerthite*, a new mineral, discovered in the neighborhood of Petersburgh ; and afterwards in Russ, the report of M. HENZ, on his expedition to Bakoer. M. FUSS, perpetual secretary, read after him, a memoir on the population of Russia, prepared by M. OUVAROF, President of the Academy.—*Rev. Ency. Fev.* 1831.

4. *Antique Medals found near Geneva.*—In November last, Dr. *Dufresne*, in digging at his country seat near Chêne, found about one hundred Roman Coins, in bronze, most of which are in perfect preservation. They are nearly all of the Emperors Constantine the Great, Constantine II. Constans, Constant II. Magnentius, Decentius, Valentinian I. One large piece, however, is of Antoninus Pius, and there are two of Marcus Aurelius, in admirable preservation, and a small number of coins of Galliënus and Claude le Gothie. This discovery is remarkable, inasmuch as coins of the Constantine family are very rarely found in this country, all those discovered for many years past being of an anterior date.

A more interesting discovery was that made one or two years ago, at Bonneville, of a small figure of Cybèle in silver, in the finest condition. This little statue, very rare, appears to be of the 2d century. It belongs to the Museum of Geneva.—*Bib. Univ. Jan.* 1831.

MECHANICAL PHILOSOPHY.

1. *Bored Wells.*—The practicability of obtaining copious supplies of running water, even in some places where a distressing deficiency of this essential article has long been experienced, has been abundantly proved, in various parts of Europe as well as in the United States. The extraordinary depths to which the sound and the borer have penetrated, in these researches, and the force with which the water has risen to the surface, and issued forth in continued jets and streams, are among the most remarkable facts in the history of hydraulics.

The French "Societe d'encouragement pour l'industrie nationale," sometime since offered medallic premiums to the engineers or artists who should be the most successful in establishing new facts or in obtaining plentiful supplies of water in situations where bored wells had not been previously introduced. The programme of the Society excited much attention in Europe, and appears to have occasioned much emulation in France.

From the report made to the Society on the 29th of December, 1830, and signed *Héricart de Thury*, *rapporteur*, it appears that eight persons had presented themselves as claimants of the reward. Of these eight, three have been successful in obtaining medals, viz.

M. *Degousée*, civil engineer of Paris, the first gold medal.

M. *Poittevin*, of Tracy-le-Mont, department de L'Oise, the second medal.

M. *Fraisse* ainé, of Perpignan, the third medal.

The first of these gentlemen, after various trials in different countries, learned that the first requisite to success was, to become well acquainted with the geological character of the country ; and that without this knowledge, time and expense will be often encountered in vain. One of the wells bored under his direction was at Fontés, department du pas-de-Calais. It was commenced at 6 o'clock in the morning and finished at 3 o'clock in the afternoon. The depth was 65½ feet. The water rose more than 6 feet above the surface, and discharged 50 gallons *per minute.*

Three wells bored at St. Gratien, 42, 52, and 55 feet deep, were completed in 25 days, and gave each of them 15 gallons per minute. They cost in the whole 187 dollars. They were bored to supply the water of the pond D'Enghein, which became so warm in summer as to destroy the fish. Another at St. Hubert was finished in 18 days, 123 feet deep, and produced a fine fountain, which rose 4 feet above the surface.

At the place Saint Gratien, in the city of Tours, the most remarkable well was bored which M. Degoussée had ever accomplished. At the depth of 320 feet, the first sheet of ascending water was attained. A second was reached at 364 feet ; and finally, a third, at about 400 feet, which issued with impetuosity about 5 feet above the surface, carrying with it a great quantity of green sand. This well was to be furnished with a tube of copper throughout its whole extent, 4 inches in diameter. It discharged 38 gallons per minute, having the temperature of 62 Fahren.; and by extending the tube, the water rose 22 feet above the pavement, and more than 50 feet above the channel of the Seine. The value of such a well to the city being incalculable, the authorities engaged the engineer to establish two others; and several neighboring proprietors determined to avail themselves of his skill on their estates. This well was the first in which the borer had penetrated, with complete success, entirely through the chalk.—*Bul. D'Encour. Dec.* 1830.

2. *On tempering metallic wires and springs.*—A bar of steel or iron, after being sufficiently hammered or subjected to the action of fire, becomes successively yellow, violet, blue, grey and white. The variations in degree of these processes will partly depend upon the state and quality of the metal operated upon. Although philosophers are agreed that all hard bodies are elastic, yet hardness does not constitute *the measure of elasticity*, for a glass ball is much more elastic than an equal globe of cast iron ; but their difference of hardness is by no means proportioned to that of their elasticity. A Damascus or Moorish sword blade is more springy or elastic than another, which shall notwithstanding make an impression upon the edge of the former. This difference arises from the varied mode of tempering the respective blades. The steel or iron, after each transition above noticed is said, by the French, to become *revenu.*

M. Le Roy, père, the celebrated watchmaker of Louis XV, informs us that he took three wires of common steel, to which he suspended weights, and put them in a pendulous motion. They did not maintain their vibrations beyond seven minutes. He then tempered them to the fourth, or grey state; in this stage of *revenu* the same wires maintained the vibrations of their masses during the space of fifty minutes. A wire of *cast* steel which maintained the vibrations of its suspended weights for ten minutes, continued them after it had passed to full blue (gros blue) an hour longer.

From Dr. Thomson's tables of cohesion, we learn that the power or force of cohesion of bar iron, is to that of cast iron nearly as seventy five to fifty; for to tear asunder rods of each species, an inch square at the base, it required seventy four thousand five hundred pounds avoirdupois, to destroy the cohesion of the particles of the bar iron rod, and fifty thousand one hundred pounds to break the cast iron rod. The elasticity or *spirit* of tempered steel springs appears therefore, to be in an inverse ratio to their power of cohesion. An untempered wire of a harpsichord, maintained its vibrations for fourteen minutes; after being tempered to grey white, it maintained its motion nearly an hour. A wire of cast steel was tempered to *gros bleu* and then was diminished (i. e. untempered) and polished, in which state it vibrated only seventeen minutes, but upon the *revenu à gros bleu*, it vibrated sixty seven minutes. These general facts seem to show the great advantage of understanding the variations of tempering, as affecting the elasticity of springs, and their consequent fitness for any required purpose. M. Le Roy applied his knowledge to the formation of the best chronometer work of the period, in which art he gained a high reputation.

Soft metallic wires and springs without temper, will not vibrate well. A copper wire is unsuited for these purposes; a brass wire is suitable in proportion to the quantity of zinc in its composition, so that it does not exceed one half; the usual proportion is four parts of copper to one of zinc. Piano-fortes strung with wires tempered *gros-bleu*, were universally acknowledged by amateurs, and by the Royal Academy of Paris to be superior in tone to instruments chorded with the usual steel wire.—*Lond. Jour. of Arts and Sciences, Mar.* 1831.

3. *Manufactured articles from Horns and Hoofs.*—A patent was enrolled, March 1829, to J. & T. Deakin, of Sheffield, for certain methods of making from horns and hoofs, various articles, such as handles and knobs of drawers, curtain rings, bell pulls, door handles and knobs, key-hole escutcheons, coverings for doors and window shutters, finger plates, knobs and handles of table knives and forks. &c.

The method of making some of these articles is thus stated:

In making a ring of horn, the required piece is first cut out of the flats, of its proper dimensions, and nearly in the shape of a horse shoe; it is then pressed in a pair of dies to give its surface the desired pattern, but previous to pressing, both the piece of horn and the dies are to be heated: the piece of horn is to be introduced between the dies and pressed in a vice, and when cold, the pattern or impression will be fixed upon the horn.

But the dies are to be so made that the open ends of the horse shoe piece of horn, after being pressed, shall have at one end a nib, and at the other a recess of a dove tailed form, corresponding to each other; and the second operation in forming this ring of horn is to heat it and place it in another pair of dies which shall bring its open ends together, and cause the dove tailed joints to be locked fast into each other, which completes the ring, and leaves no appearance of the junction.

In forming the handles of table knives and forks, or other things, which require to be made of two pieces, each of the pieces or sides of the handle, is formed in a separate pair of dies; the one piece is made with a counter sunk groove along each side, and the other piece with corresponding leaves or projecting edges. When these two pieces are formed by being first cut out of the flat horn, then pressed in the dies in a heated state, for the purpose of giving the pattern, the two pieces are again heated and put together, the leaves or edges of the one piece dropping into the counter sunk grooves of the other piece, and being introduced between another pair of heated dies, the joints are pressed together, and the two pieces formed into one handle.

In making knobs for drawers, which have metal stems or pins to fasten them into the furniture, the face of the knob is to be first made in a die, and then the back part of the knob with a hole in it; a metal disk of plate iron is then provided, in which the metal stem or screw pin is fixed, and the stem being passed through the aperture in the back piece, and the two pieces of horn put together, they are then heated and pressed in dies, as before described; the edge of the back piece falling into the counter sunk groove of the front piece and by the heat they are perfectly cemented together.—*Ibid.*

4. *Thunder Storms in France.*—The Count de Triston has made observations on the direction of the thunder storms which have devastated the department of the Lorich for the last sixteen years. The following general inferences have been made by him respecting the progress and intensity of thunder storms in plain countries, inter-

sected by shallow valleys. Thunder storms are attracted by forests. When one arrives at a forest, if it be obliquely, it glides along it; if directly, or if the forest be narrow, it is turned from its direction; if the forest be broad, the tempest may be totally arrested. Whenever a forest, being in the path of a thunder storm, tends to turn it aside, the velocity of the storm seems retarded, and its intensity is augmented. A thunder cloud which is arrested by a forest, exhausts itself along it, or, if it pass over, is greatly weakened. When a large river or valley is nearly parallel to the course of a thunder storm, the latter follows its direction; but the approach of a wood, or the somewhat abrupt turn of the river or valley makes it pass off. A thunder cloud attracts another which is at no great distance, and causes it to deviate from its course. There is reason to believe that the action is reciprocal. A cloud attracted by a larger, accelerates its motion, as it approaches the principal cloud. When there is an affluent cloud which was committing ravages, it sometimes suspends them on approaching the principal mass, which is perhaps a consequence of the acceleration of its course; but after the union, the evil generally increases. Twenty one thunder storms whose course has been distinctly traced, have extended from N. N. W. to S. S. W. No destructive thunder storms have come from any other points of the horizon. Lastly, the position and form of the forest of Orleans, Blois, &c. satisfactorily accounts for the frequency of hail storms in certain communes, and their rare occurrence in others.

5. *Aurora Borealis at Paris.*—The following are the magnetic observations made at the Observatory of Paris, on the Aurora which was visible on the night of the 7th of January. The Aurora caused a deviation of the magnetic needle in variation.

A declination equal to 1° 6′ 47″.

An inclination equal to 0° 28′ 00″.

N. B. The variations of the magnetic needle, in declination, can be appreciated to five seconds at the Paris observatory.

6. *Lightning Tubes.*—In the vicinity of the old castle of Remstein, near Blenkenburg, which stands on a picturesque series of rocks, belonging to the green sand, or quadersandstein formation, in a loam land, there have been found this summer, very firm and long vitreous tubes. From a branch in the upper part, two branches go off, some of which are ten feet long, and from these proceed three small branches.—*Literary Gaz. Jan.* 15, 1831.

OTHER NOTICES.

1. *Exchanges of organized remains.*—In a letter dated Heidelberg, May 17, 1830, to the editor, written by Prof. C. H. Bronn, that gentleman enquires, whether there are persons in this country who are disposed to exchange fossil organized remains; he is inclined to obtain those of North America from persons situated in different states where there are organized remains, to furnish those of Europe in exchange, and to add the names which they sustain in Germany. He mentions some of our most distinguished naturalists, with whose labors he appears to be well acquainted, and he wishes us to excite an interest among those, who have the best opportunity and the strongest inducement, to collect specimens, principally from the more ancient formations, which he regards as the most interesting; he is aware that they are extensively diffused in the states of Pennsylvania, New York, (he names Trenton Falls, Albany, Black River, Plattsburgh, Hudson city, Lakes Seneca, Erie, Ontario, &c.) Canada, (Falls of Montmorency, Ottowa River, York, Lake Huron,) and in the Cattskill mountains.

He adds, "If my offers should be acceptable to any person, I will endeavor, in the course of half a year at most, to collect and prepare what may be most interesting to them, (as soon as I shall have been informed what may be agreeable.) That we may be mutually informed what will be an equivalent, each should advise the other of the number of species of petrifactions which he can furnish, and to avoid unnecessary expense in transportation, that each particular parcel (*envoi*) should neither be too small nor burdened with specimens which are imperfect, or too heavy in proportion to their value."

It will afford us much pleasure if, through the medium of this Journal, we can call the attention of naturalists throughout the United States and Canada, to the interesting object proposed by Dr. Bronn. Such exchanges cannot fail to be highly useful, and it remains principally for our young and active collectors, not yet embarrassed by too much duty, to avail themselves of the present advantageous opportunity.

The field of organized remains in this country is vast, and much of it is of the geological age indicated by Dr. Bronn, that is what is usually called the transition and older secondary, which cover so large a part of the states of New York, Pennsylvania, &c. It is far from being true that it has been adequately explored, and it cannot be doubted that interesting discoveries are still to be made.

2. *Heidelberg collection of minerals, petrifactions, and models of crystals.*—I. *Oryctognostic collections;* classed after the manual of orytognosy of Prof. Leonard.

a, In beautiful paper cases of four drawers, 100 specimens from 11 to 24 florins.

b, In five drawers, 150 specimens, 22 fl.

c, Without cases, 300 specimens of larger size, 66 fl.

d, Id. 400 Id. of 4 inches square, 110 fl.

II. *Collections of precious stones.*

a, In beautiful paper cases, 50 specimens, the greater part polished, 66 fl.

b, In beautiful paper cases, in greater number and larger size, at any desired price.

III. *Geognostic collections*, after the characteristic rocks of Mr. Leonhard.

a, In paper cases, 100 specimens, 4 square inches, 11 fl.

b, Id. 150 specimens, 22 fl.

c, Without cases, 150 specimens of 9 sq. in. 33 fl.

d, Id. 200 Id. Id. 55 fl.

IV. *Pharmaceutical collections*, after the system of Mr. Geiger, price and number of the specimens as in I.

V. Collections in economical mineralogy, for the use of public schools and polytechnic institutes, after Mr. Blumhof or Brard.

a, 300 specimens, of 6 sq. in. 77 fl.

b, 400 Id. Id. 121 fl.

VI. Collections of petrifactions after the system of Mr. Bronn.

a, 100 specimens, 33 fl.

b, 200 Id. 77 fl.

VII. *Suite of models of crystals*, made of paper and covered by a beautiful varnish.

a, 23 specimens respecting the primitive forms, 4 fl.

b, 100 Id. Id. and also 77 secondary forms, 16 fl.

All the specimens of the different collections are well selected and fresh, and equally adapted for study or instruction; they are labelled as to species and locality and if desired both in French and English.

The collections are arranged according to any system, that may be preferred. Collections will be furnished of every species in larger number and size, and of rich crystallizations, and of rare and precious minerals as may be desired according to any price that may be agreed on.

Catalogues (raisonnês,) of the magazine of minerals and of rocks and petrifactions are furnished gratis. (Forwarded to the Editor and inserted by desire.)

3. *Gum Ammoniacum.*—Linnæan Society, Dec. 9, 1830.—A paper was read on the plant which yields the gum ammoniacum, by Mr. David Don, Lib. L. S.—Although the gum ammoniacum has held a place in the Pharmacopœia from a very early period, yet the plant itself has hitherto remained wholly unknown. It proves to be a new genus, belonging to the group of *Umbelliferæ*, named by DeCandolle *Peucedaneæ*, differing essentially from *Ferula* and *Opopanax*, in its large cup-shaped epigynous disk, and in having solitary resiniferous canals. The specimen was obtained, in the districts where the gum ammoniacum is collected, by Lieut. Col. Wright of the Royal Engineers, on his way through Persia from India, and was by him presented, along with other dried plants to the Linnæan Society. Every part of the specimen is covered by drops of a gum, possessing all the characters of gum ammoniacum, and this circumstance alone would seem sufficient to remove all doubt on the subject, but Mr. Don has carefully compared it with the fruit and fragments of the inflorescence found intermixed with the gum in the shops, and he finds them to accord in every respect, so that the plant may now be considered as fully ascertained. Dioscorides derives the name Ammoniacum from Ammon or Hammon, the Jupiter of the Libyans, whose temple was situated in the desert of Cyrene, near to which the plant was said to grow; but as the plant is now ascertained to come from the north of Persia and not from Africa, Mr. Don is disposed to consider the name Ammoniacum or Armoniacum, as it is indifferently written by ancient authors, as merely a corruption of Armeniacum. We subjoin Mr. Don's essential character of the genus, and some of the more important parts of the detailed description.

Dorema. Discus epigynus cyathiformis. Achenia compressa, marginata; costis 3 intermediis distinctis, filiformibus. Valleculæ univittatæ. Commissura 4vittata.

Herba (Persica) robusta, facie fere Opopanacis. Folia ampla, subbipinnata. Umbella prolifera, subracemosa. Umbellulæ globosæ, breviter pedunculatæ. Flores sessiles, lanugini immersi!

The species is Dorema Ammoniacum.

Mr. Don concludes his paper with a few observations on the plant which yields the analogous gum Galbanum, which he regards as also constituting a new genus allied to Siler, but differing essentially in the absence of dorsal resiniferous canals to the fruit, and in the commissure being furnished with two only. He proposed for the plant the name of Galbanum officinale. The Bubon Galbanum of Linn. possesses neither the smell nor taste of Galbanum, and is altogether a totally different plant.—*Phil. Mag. and Ann. of Phil. Jan.* 1831. —*No.* 49. *N. S.*

DOMESTIC.

1. *American Marine Conchology: or Descriptions and Colored Figures of the Shells of the Atlantic Coast of North America.* By T. A. Conrad. Philadelphia: printed for the Author.—The first number of a work by the above title has just made its appearance, and relying solely upon its own merit, has been modestly offered to the scientific world. We can truly say it deserves success.

The plan proposed by the author is to give monographs of each of the genera. Such species as may be subsequently discovered, will be given in a supplement. The work will appear in numbers every two months, each number to contain two colored plates, at the low price of three dollars per annum. It is supposed that eighteen numbers will be sufficient to contain the whole of our marine shells.

In the present number the author has been eminently successful—his descriptions are clear and his observations always pertinent. We are acquainted with the ability and industry of Mr. Conrad, and most heartily wish him success in the present undertaking. We shall hail the completion of the work as a desideratum in our Fauna, and we feel assured that every conchologist will be desirous of placing so desirable an assistant to his studies on his table.

The work is beautifully printed on fine paper, and the figures are elegantly executed, and colored with care and accuracy.

Works of this kind in all the branches of the natural history of our country would be exceedingly useful, and if as well executed, and at so reasonable a price as this, could not, we think, fail of success.

The genus *pecten* is given in the present number, which contains the following species:

Pecten Magellanicus,
" Concentricus,
" Purpuratus,
" Pealeii,
" Ornatus.

2. *Projected Branch Mint of North Carolina.*—A report on this subject recommends that application be made to Congress for power to establish a branch mint in North Carolina, that the value of their gold may be ascertained at home, and that thus, by being issued first in the state, it may be turned to more immediate and profitable account: at present, owing to the different value of gold from the various mines, and to the adulterations, gold bullion no longer passes as money in commerce, and much loss of interest is sustained, while it goes to Philadelphia to be assayed. Mexico is stated to have provincial mints, besides one at the metropolis.

It appears that the sum of $500,000 has been obtained during the late year (1830,) in North Carolina, by employing a capital of $150,000 in the gold business. Agriculture, it is stated, has thriven in consequence of the increased demand for its productions at cash prices, and the bills of North Carolina—three years since at 8 per cent discount—are now at par.

It is supposed that much of this gold used in the arts will be fabricated at home, and thus North Carolina may supply other communities with useful and ornamental articles, as Geneva supplies Paris with gold watches.

The importance of the Gold mines of North Carolina is also much enhanced by the alledged decrease of the precious metals—of which the following is a summary tabular exhibition of the sources of supply, and of the diminution.

	Previous to 1810.	Subsequent to 1810.
Europe and Asia	$4,000,000	$5,000,000
Indian Archipelago	2,980,000	2,980,000
Africa	1,000,000	1,000,000
America	47,000,000	15,000,000
Total,	$54,980,000	$23,980,000

Decrease of the annual supply since 1810, 31,000,000 dollars, amounting, during the last nineteen years to an aggregate of 589,000,000 dollars.

But it is not alone this extraordinary decrease in the supply to which the rise in value of the precious metals is attributable. Besides this, there has been a great increase in the demand for gold and silver, since 1810, consequent in part upon the augmented consumption.

The number of gold and silver watches manufactured in France was, in 1789, 200,000, and in 1819 had increased to 300,000. At present it is stated at 400,000.

In Mr. Huskisson's speech of 18th May, 1830, it is stated that the duty upon wrought gold and silver had risen in net produce, from less than £5,000 in 1824, to upwards of £105,000 in 1828—'a rise more than twenty fold, notwithstanding the greatly diminished supply from the mines, and the consequent constantly increasing value of the precious metals." A numerical statement of the actual supply and demand of the precious metals for the last nineteen years gives the following result. The supply for these nineteen years being estimated at 23,980,000 annually, making an aggregate of 435,980,000. Taking the metallic currency of the world at 3,000,000,000 of dollars, and estimating the wear and tear, recoining, and loss by shipwreck, at 2 p. mille, annually, it would in nineteen years amount to $114,000,000

The increase of the absolute quantity which has become requisite since 1810, estimating at 6 per cent.	180,000,000
The chasm in circulation occasioned by withdrawing paper money since 1815, and since filled up by gold and silver coin,	300,000,000
And finally, the consumption of the precious metals by artificers, &c. at 30,000,000 dollars annually, amounts in nineteen years to	570,000,000
Total demand since 1819,	1,164,000,000
Deduct supply from mines,	455,620,000
The deficiency appears to have been	708,380,000

The total produce from the much celebrated Ural mines in Russian Asia, from 1814 to 1824, has not exceeded, according to Humbolt's estimate, $17,000,000 i. e. $1,700,000 annually. By the most recent accounts from Chili, the yearly produce of the mines is stated to be 190,000 dollars, including, as would seem, silver as well as gold.

For the last nineteen years all Brazil is not estimated to have exceeded an annual average of $1,240,000. Peru, which, from 1752 to 1801, had yielded annually upwards of 2,000,000 dollars, by the last accounts, produced nothing worth mention. By a report from the Executive government of New Grenada to Congress, it is stated that the mines in 1822 produced 1,270,000 dollars, as would appear of silver and gold, and this amount has been since greatly diminished.

North Carolina possesses adventitious advantages, in a healthy country, abundant supplies, cheap labor, and prompt returns. The auriferous veins of North Carolina, crop out at the surface, and in this state, such treasures are obtained by slight movements of loose materials, as in some countries are collected at great depths.

Great waste has been committed in Mexico; extensive amalgamation works have been destroyed in civil war, and the mines have become filled with rubbish and water. In many of the Hispano-American mines, necessary supplies and aids are obtained with difficulty. At the Etoria Mines in Mexico, a small timber for a stamping mill costs $600; and to the St. Ana mines in Colombia, now worked by English capital, nothing can be transported except on the heads and shoulders of Indians, access even by mules being impracticable.

We are not informed whether Congress have acted upon the subject of the North Carolina Mint, the demand for which appears to be reasonable, provided it interferes with no important principles of national domestic policy.

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The following facts are cited from the official report of the director of the mint, (Dr. Moore,) for the last year, 1830.

The coinage effected within that period, amounts to $2,306,875 50 comprising $295,717 50 in gold coins, $1,994,578 in silver, and $16,570 in copper, ; and consisting of 7,694,501 pieces of coin, viz.

Half Eagles,	57,442	pieces,	making	$287,210.00
Quarter Eagles,	3,403	do.	do.	8,507 50
Half Dollars,	3,712,156	do.	do.	1,856,978 00
Dimes,	770,000	do.	do.	77,000 00
Half Dimes,	1,230,000	do.	do.	61,5000 00
Cents,	1,414,500	do.	do.	14.145 00
Half Cents,	487,000	do.	do.	2,435 00
	7,674,501			$2,306,875 50

Of the amount of gold bullion, deposited at the Mint, within the last year, about $131,000 were received from Mexico, South America, and the West Indies ; $22,000 from Africa ; about $12,000 from sources not ascertained ; and the residue, about $134,000, from North Carolina, and the adjacent States of South Carolina and Virginia. The proportion from North Carolina may be stated at $128,000 ; that from South Carolina at $3,500, and that from Virginia at $2,500.

The first notice of gold from North Carolina, on the records of the Mint, occurs in the year 1814, within which it was received to the amount of $11,000. It continued to be received during the succeeding years, until 1824, inclusive, in varying amounts, all inferior however to that of the year first mentioned, and on an average not exceeding $2,500 yearly. In 1824, the amount received was $5,000 ; in 1825, it had increased to $17,000 ; in 1826 it was $20,000 ; in 1827 about $21,000 ; and in 1828, nearly $46,000. In 1829, as above stated, it was $128,000.

This remarkable increase in the amount of gold received from North Carolina, during the years following 1824, has been considered of sufficient interest to be noted in the annual reports from the mint, since that period. The circumstance will attract additional attention, from the fact now ascertained, that the gold region of the United States extends far beyond the locality to which it has heretofore appeared to be limited. Gold bullion had not been received from Virginia or South Carolina, until within the last year ; or, if at all received, it has been in quantities too inconsiderable to have been specially noticed. The gold from all these localities is found, in its native state, to be, on an average, nearly of the same fineness as the standard of our gold coin.

Some additional observations on the gold mines of the Carolinas, which arrived too late for this number, will appear in the next.

3. *Electrical properties of Caoutchouc.*—Prof. Walter R. Johnson, in a paper read to the Academy of Natural Sciences, April 20, 1830, has developed the electrical properties of caoutchouc, and states some novel results and applications.

Although Dr. J. K. Mitchell had before placed it among non-conductors, Mr. Johnson has shewn that it is one of the most perfect non-conductors. In the common process of removing pencil marks from paper, much of the latter, with the crayon and some of the abraded rubber itself, adheres to the firm part of the latter, chiefly at the last stage of the rubbing, by an electrical attraction, and accordingly, when the hand is passed lightly over the rubber, the adhering matters drop off, because the hand conducts away the electricity.

When a piece of India rubber is pressed closely upon the brass cap of a Bennet's gold leaf electrometer, and suddenly withdrawn, the leaves will diverge and strike the sides of the glass; if the rubber is simply stretched and applied, the excitement is feeble, especially if slowly withdrawn, "while a smart separation causes the leaves to diverge at once to their greatest extent." The production of heat, when a thong of caoutchouc is held against the lips and suddenly pulled to the utmost, and at the same moment pressed hard, is well known.

According to Dr. J. K. Mitchell, the caoutchouc, even in the extreme thinness to which he reduces it by his peculiar mode of expanding it, by blowing after immersion in ether, entirely prevents the passage of the electric spark from the prime conductor; it is however probable that it would be lacerated by the discharge from a powerful battery.

The remainder of Mr. Johnson's paper, we quote entire.

"The fact, however, that it has a power of resisting to a considerable extent, points it out as a good medium to be interposed between the two surfaces of the condenser, or substituted in some form for the Leyden phial.

"For this purpose, a piece of gum, reduced to a very thin sheet, may be interposed between two sheets of tin foil and laid upon a table; a thicker sheet of gum may then be laid upon the upper sheet of foil, so that the edge of the latter should be at some distance from that of the former. The whole may then be rolled up into a coil, allowing a small part of the included tin foil to project out at one end of the roll. A charge may now be given to this apparatus, and a shock obtained by connecting the outer sheet of tin with the part of the inner, projecting at the end.

"A disk of metal may be covered with a thin sheet of caoutchouc and another disk furnished with an insulating handle placed above it; this apparatus will serve all the purpose of the ordinary condenser.

"I have stretched a piece of gum upon a circular piece of board, six inches in diameter, with a coat of tin foil underneath; on rubbing this with flannel, it becomes highly electrified, and if a plate, like the upper or receiver plate of the electrophorus, be placed upon it and touched, it will evince a very vigorous action on the electroscope.

"This effect may be increased by the use of the condenser, and even a common Leyden jar may be charged in favorable weather to a considerable degree of intensity.

"By a single contact of the plate of this electrophorus so much electricity is sometimes developed, that it will communicate to a pin's head, electricity enough to turn the small needle of the silk thread torsion balance through two or three revolutions.

"The non-conducting property of caoutchouc may be profitably employed in the construction of torsion balances, for measuring the intensity of electrical action. For this purpose a string of the gum, of any convenient thickness, may be cut from a sheet or bag, making it as nearly as practicable of *uniform* thickness. This may afterwards be reduced to the required size by treating it with ether, stretching it and allowing it to remain distended until the ether is fully evaporated. A small longitudinal hole may then be made at one end, through which a needle of gum shellac, carrying a disk of metal, or what is better, a very thin spherical bag of caoutchouc at one extremity, may be accurately adjusted on its centre of gravity. *Insulators* of this substance may be formed either in plates, strings, or conical portions of bags to support any required apparatus.

"Hence it appears that nearly a complete set of electrical apparatus may be formed of this substance, capable of being transported with perfect ease and safety under circumstances in which the common apparatus would be inevitably demolished. In a large bag, or extended sheet, it may be used for the *cylinder* or *plate* of the common machine. A portion of the same may be substituted for the *rubber*. The electrophorus, the condenser, and the Leyden jar may be formed of it. The torsion balance constructed with balls of this substance instead of pith balls, is an instrument far preferable to that of Coulomb. The jar may receive either the coiled form already described, or it may have the usual form by making the inner coating of tinned iron, covering it with a thin sheet of gum, and then adding an exterior coating of metal."

4. *Geological remarks relating to Mexico, &c. in a letter dated Mexico, May 30th,* 1830, *from* William Maclure, Esq.—The regular order of original stratification has been so much deranged in this country by the intimate and frequent alternation of volcanic

rocks, as to have subverted the original order of nature and to change the class every mile; this leaves the geologist in doubt concerning the substrata, and would reduce most of his investigations to hypothetical results. The brilliancy of the precious metals has so fixed the attention of all travellers, miners, and mineralogists, that the only specimens to be met with are derived from what they call veinstones; so true is this, that a gentleman who wished to acquire a little knowledge of geology, could not find in Mexico a specimen of granite, gneiss, or mica slate; any assortment of rocks, to be found here, comes from Fryberg in Germany. From this great scarcity of materials, and still greater difficulty of procuring them, any thing resembling a general description must be a hypothesis formed from the small spots above the principal mines that have been wrought in following the metallic veins to a great depth.

From the great range of the Andes, spring all the subordinate mountains, forming large plains or valleys either near their summit or on the planes of their descent on either side, on which planes, below the level of the principal range, when not covered by the volcanic formations, the greatest part of the primitive crops out to day. On the tops, both of the great range and the subordinate heights, appears to be placed the seat of the mines, principally in transition, though some are thought to be in primitive shist or marble, from which it would appear, that the summits of the mountains are principally transition. This supposition is countenanced by the small quantity of well defined primitive found in the vicinity, and by its appearing at a lower level on both sides; this seems to indicate that the primitive is the formation of the whole range. Having gone so far without sure footing, the speculation may be pushed a little further for our amusement if not for our instruction, while we indulge some conjectures as to the mode of origin. The patches of secondary limestone with shells, and the quantity of minute particles like sand, which I suppose to have been cinders reduced to a level in the plains, would indicate submarine volcanos, and in all probability, the secondary limestone with shells could not be superposed on the volcanic by any agent except water, and the quantity of cinders that would be formed by the quick cooling of the lava by ejection into the sea may be considered as a collateral proof.

Most of the veinstones, I have seen, which are the principal specimens in all collections, are secondary; generally very poor in the useful metals, so as not to pay for working unless the wages are exceedingly low and the work performed by laborers who live on little. This secondary may be considered as a proof if ever the veins were filled, that they must have been filled from the surface, for it is difficult to conceive how, in a primitive range, the secondary could be ejected from below; it has been considered as a geological fact, that metallic veins can have no dependence or connection with volcanos, yet our total ignorance of many original natural methods of operation, ought to make us cautious in restricting nature to any exclusive mode of acting. Our primitive mountains in the north have iron in abundance, but the precious metals have, as yet, been rarely found; nor are there any modern volcanic rocks. The same may be observed in the north of Europe. Sweden, and the north of Germany, have rarely silver and gold, and no modern volcanic rocks, whereas, in Saxony and Hungary and Spain, there are both precious metals and volcanic rocks—and on the southern continent of America, there seems to be a proportion between the gigantic volcanic formation and the abundance of the precious metals. If we suppose the convulsions and earthquakes that might precede the eruption of lava to the surface, to have rent and cracked the shell so as to give space to the formation of these veins, and the precious metals if converted into vapor, would penetrate through chinks that would not permit lava to pass; this vapor meeting with the secondary that was filling the vein from the surface, might form a mixture such as we find in most of the veinstones; this conjecture will not support the fashionable theory of the central fire, for there would be no good reason why the cracks in our northern mountains were not as near the melted mass, and therefore as liable to be filled with the vapor of the precious metals as the rocks of the inter-tropical countries.

5. *Aluminium and magnesium.*—Lieut. W. W. Mather, of the Military Academy, West Point, has succeeded in obtaining the chlorides of aluminium and magnesium, and in decomposing them by potassium, so as to obtain the metallic base both of alumina and of magnesia. The magnesium that he obtained, had not a distinct metallic appearance until it was burnished, but both it and the aluminium were combustible when heated in the air.

Lieut. Mather was so good as to enclose to us a portion both of the aluminium and magnesium, whose metallic appearance is quite distinct; the color of the aluminium is light grey and in spots tin white. The chloride of magnesium obtained by him has exactly the appearance of the lamellar hydrate of magnesia of Hoboken, N. J.; and that of the aluminium has a bright sulphur yellow color, the crystals standing out from the sides towards the centre of the tube in which it was formed. Lt. Mather obtained about one ounce of each of these chlorides at a single operation for each.—*Extract of a letter, of April* 20, 1831, *to the Editor.*

6. *Pure chromate of potash.*—M. Zuber has published a process for examining this salt, by means of tartaric acid, which is considered as objectionable, on account of his selection of an acid, which is rarely found in a pure state, and which forms with a solution of the chromate, a very compound solution, in which the indications of re-agents are not precise.

It is better to use colorless nitric acid, adding about half a part to the salt in solution, a *drop* of a solution of nitrate of baryta, will occasion precipitation, if sulphuric acid is present, or, a like quantity of nitrate of silver, will cause the deposition of chloride of silver, should muriatic acid contaminate it. Both chromates of baryta and silver, are soluble, to a considerable extent, in chromic and nitric acids, and if the reagents are not added in excess, there is no precipitation, if pure chromate of potash is in solution. An extension of this method furnishes us with the salt in a state of purity. The chromate of commerce is to be re-crystallized to remove the silicate of alumina and oxide of iron, dissolved in water, nitric acid to displace one half of the chromic is added and the liquor heated; moist chromate of baryta may be dropped in, until the heavy sulphate ceases to fall, the liquor filtered, and chromate of silver mixed with it, so long as the curdy chloride is formed, when it is again filtered and the clear liquor evaporated to a salt and heated to redness in a platina dish; the mass dissolved in water, affords crystals of the pure salt by slow evaporation. It is impossible to remove sulphate of potash from this salt by the processes of re-crystallization and solution.—A. A. Hayes.

7. *Covering for wires.*—Mr. A. A. Hayes recommends mastic colored by vermillion, or otherwise, as a very excellent substance for covering the wires of galvanoscopes. Mr. H. melts it in a saucer and slides the wire under the surface of the resin, by fastening a stick across the saucer so as to have its edge dip; then it is wound in a coil or spiral. Its superiority is due to its tenacity when gently warmed.

8. *Prof. Joslin*, of Union College, has published an ingenious memoir on vision; presenting some novel facts and opinions, which cannot fail to be interesting both to the anatomist and optician.—See Phil. Jour. of the Med. Sciences for May 1831.

9. *Problem.**—To assign rational numbers for the length of the sides of a right-angled triangle. Assume m, n, p, any rational numbers, so that $n>p$. Then $m(n^2+p^2)$, $m(n^2-p^2)$ and $2mnp$ will be the sides of the required triangle.

Demonstration: $(m^2(n^2-p^2)^2+(2mnp)^2)^{\frac{1}{2}}=m(n^2+p^2)$.

Example: Put $m=1$, $p=1$, $n=2$; then by the foregoing formula we have the sides of a well known right-angled triangle, viz. 3, 4 and 5.

10. *Topaz in the White Mountains of New Hampshire.*

Extract of a letter from Prof. Hitchcock to the Editor, dated June 9, 1831.

Mr. Oakes, of Ipswich, showed me, the other day, an interesting specimen from the White Hills. He labeled it, " from the falls of Amonoosuck, one mile and a half, down the river, from E. A. Crawford's—White Mountains—close to the road—a single loose specimen." It is a coarse granite, whose felspar is flesh colored and the quartz smoky; both being distinctly crystalized. Mixed with these, are several prismatic terminated crystals, which I have little hesitation in saying are topaz! For they have the hardness of that mineral, and exhibit a lamellar structure at right angles to the axis of the prism—a character, which I have found very decisive of this mineral when crystalized. These crystals are limpid, and resemble very much the topaz from Brazil.

11. *Marl for manure.*—We have received a specimen of calcareous materials mixed with earthy matters from Mr. Durner Oakes of Baltimore. It appears, from trial by acids, to contain from one half to two thirds of calcareous matter, evidently the ruins of disintegrated and decomposed shells, among which, pectens are numerous, and is obviously a portion of a great oceanic deposit, similar to those found so extensively from New Jersey to Florida and Louisiana.

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* *Remark.*—The author (Mr. Gould,) became acquainted with Mr. Wheeler's problem, in consequence of reading the proof, and therefore his problem is allowed to appear in the present No. Since the above was in type, he suggests, that he has found the same solution in Bonnycastle's Algebra.

Mr. Oakes informs us that the marl, now mentioned, is on the Chesapeake Bay, about sixty miles from the capes, and the deposit is so extensive that millions of bushels may be obtained. It is convenient to navigation, and it is supposed that it may be delivered on board of vessels at four or five cents a bushel. How far this material may admit of transportation to distant states we cannot say, but it admits of no doubt that on certain soils it must be a very valuable manure, and we should be pleased to have the experiment tried within those States, which can obtain it with facility.

The subject of marl has received but little attention as yet in this country, parts of the Western States, and particularly in the eastern states, while it is well known that it is highly efficacious in other countries, and in some parts of this. On the territory of James Wadsworth, Esq., and of his brother, General Wadsworth, at Geneseo, New York, the soil contains a natural marl, which renders it permanently fruitful in the production of wheat so that it needs not the usual additions of animal and vegetable matter.

12. *Iodine in Angina Pectoris.*—The case of Dr. B. Lynde Oliver, was mentioned in Vol. XVI, p. 176. From the same gentleman, under date of May 28, we derive the following statement.

Mr. Worthington, near Baltimore, had been for about five years afflicted with the Angina Pectoris, to such a degree, that while walking he was obliged to stop and stand still two or three times in every hundred yards, and during the above period he had no intermission of his symptoms. He then took the Iodine, agreeably to Dr. Oliver's prescription,* and in one fortnight was able to walk six miles without any inconvenience, and with no more fatigue than he had usually felt when his health was good. On a return of the symptoms, the iodine was again and again resorted to, and as often assuaged the complaint. In a more recent letter, Mr. Worthington says that he has for seven months enjoyed good health, having a regular pulse, and no symptoms of the Angina Pectoris, except from great fatigue or excitement, although he was occasionally seized with great weakness. With an abstemious diet, a regular life, and an issue in his arm, he had been able to live for a good while without the iodine.

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* Solution, 20 grs. iodine to 1 oz. of alcohol, taken three times in a day, beginning with six drops, and gradually increasing the dose to 16 or 20.

Dr. Oliver states that in his own case he had been obliged several times to return to the use of iodine, and always found relief. Under the pressure, however of a catarrhal affection, and great mental anxiety and suffering, on account of the sickness and death of an only brother, an inmate of his house, the palpitation of the heart returned, with extreme irregularity of pulse, threatening sudden death. In this case he derived great benefit from the Prussic acid, and is now convalescent.

13. *New Monthly Journal.*—No. I. of this work, devoted to Natural Science, and especially to Natural History, will appear July 1, edited by G. W. Featherstonhaugh, Esq. The numbers will contain fifty pages each, with engravings. The publisher and proprietor is Henry H. Porter, Literary Rooms, 121 Chesnut street, Philadelphia. The price is $3.50 per annum.

14. *Magazine of Useful and Entertaining Knowledge*, by N. Sargent, and Ab. Halsey.—This agreeable and valuable Journal has nearly finished its second year. It is published monthly, and contains papers original and selected, on most subjects relating to science, arts, literature, and other great interests of mankind; it is well worthy of encouragement, and as it occupies a station midway between the technical journals of science and elaborate literary reviews on the one part, and the fugitive diurnal and weekly journals on the other, it must be both useful and entertaining to a large portion of the reading community.

15. *Journal of the Franklin Institute.*—This very useful Journal appears with punctuality, is ably conducted by Dr. Jones, and we cannot doubt, performs an important service to the rising arts of this country, while it keeps progress with the science of the age. We know not where the American reader will find more that is valuable, especially to the practical arts, and patented inventions. The number for May last contains articles on the use of salt water in steam boilers—on splicing a water wheel shaft,—and a reply to Mr. J. Shaw's observations on H. Bell's patent; besides the proceedings of the Franklin Institute, and a list of American patents, with their specifications.

16. *Mr. Cooper's Disclaimer.*

New York, 28th April, 1831.

TO THE EDITOR.

Sir.—In the last number of your valuable Journal, p. 123, I find, to my great surprise, an opinion attributed to me, relative to a fossil described by Mr. Eaton, so different from what I have ever entertained or expressed to any person whatever, that I must beg the favor of you to insert my disclaimer of it in your next number. The fossil in question was shown to me in September last, when I intimated that it was a plant, and not, as supposed by Mr. Eaton, an animal. Similar vegetable impressions are represented in Plates 1 and 2, vol. III, of the American Journal, as well as in Parkinson's and other works on Fossil plants. They belong to the genus *Lepidodendron*, of Sternberg and Brongniart, of which thirty species are now known, including those formerly confounded under the name of *Phytolithus cancellatus*. They are supposed to have much affinity with the *Lycopodiaceæ;* and are therefore widely different from Arundo, or any of the Gramineous Family.

I remain, with great respect, your obedient servant.

WM. COOPER.

17. *Education.*—In this great and growing country, it is very gratifying to observe how much the public mind is directed towards education, for this alone can insure a healthful state of public opinion, which is the supreme law of the land.

In this view, the efforts of Mr. Joseph Holbrook, in Massachusetts, to bring as much valuable knowledge as possible within the reach of the most numerous class of society, are well known, and deserving of respect and commendation.

A member of the Albany Institute, (said to be Mr. Bloodgood,) has recently presented to that body an interesting memoir on Education, especially as conducted according to the systems of Lancaster, Bell, Fellenberg and Pestalozzi; and more particularly of Jacotot, of Flanders, whose name is little known in this country. The pamphlet* is well worthy of an attentive perusal. The system of Jacotot is founded upon memory, in the first instance, and the improvement of the pupil is stated to be rapid beyond all former experience, especially when it is considered how limited are the literary means employed. The pamphlet must be consulted for the details. The au-

* Published by E. Bliss, 111 Broadway, New York.

thor of the pamphlet, faithful to the most important interests of mankind, regards their moral and religious interests as superior to all others, and justly considers all systems as defective which leave them out of view, and of course as erroneous if they tend to pervert the mind of the youthful pupil.

18. *Journal of the Academy of Natural Sciences of Philadelphia.*—The April No. contains communications,

1. On the electrical properties of Caoutchouc,* by Prof. Johnson.
2. On two new species of Salamander, by Prof. Jacob Green.
3. On fifteen new recent and three fossil species of shells, by T. A. Conrad.
4. On the fossil bones of the Megalonyx, by Dr. R. Harlan.
5. On a fossil fucus, by the same.
6. On some parasitic worms, by Dr. S. G. Morton.
7. On new American Hemopterous insects, by Thomas Say—in continuation, &c. &c.

In proportion to its age, no institution in this country has done more for science than the Philadelphia Academy, and its museum—which is extensive and various, and kept in fine order—has received, during the last year, a valuable addition, in a collection of fossils; being that made by the late Mr. Clifford, of Kentucky, and till recently kept at Cincinnati. It has been purchased by Mr. J. P. Wetherill and generously presented to the Academy. In this collection are some bones of the Megalonyx, from the White Cave in Kentucky.† These bones form the subject of an interesting memoir, by Dr. R. Harlan, who observes, that with teeth constructed after the manner of those of the sloth, the skeleton presents a singular admixture of characters, peculiar to the Ant-eater, the Armadillo and the Orycteropus. Mr. Harlan infers that the Megalonyx is about one third less than the Megatherium, which Cuvier estimated to be seven feet and four and a half inches high; and that the individual Megalonyx, whose bones Dr. Harlan examined, was about five feet high and of the size of a common ox, although it did not appear to be more than three fourths grown. Along with the

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* Of which an abstract is given in the present number of this Journal.

† In Edmonston County, one hundred and twenty miles south west of Lexington, on the bank of Green River. It is one of the saltpetre caves, which are numerous in the limestone regions of the West, and in which human mummies, dried and imputrescible, have been often discovered, being the bodies of some of the aborigines.

remains of the Megalonyx were received portions of the skeletons of the bos, the cervus, the ursus and a metacarpal human bone.

Dr. Harlan has also described a fossil fucus of singular beauty, found in the compact sandstone subjacent to the coal formations, on one of the eastern ridges of the Alleghany, one hundred and fifty miles from Philadelphia, ten miles east of Lewistown, Mifflin County. A fragment of a stone, two and a half feet long by one and a half wide, is completely crowded with the forms of this plant, lying upon each other three or four layers deep; the stone seen at a short distance presented the appearance of beautiful artificial sculpture. This fossil fucus not unaptly resembles the fingers of a hand branching from the palm.

Only two fossil species of fuci have been before found in North America. It is observed by M. Brongniart, that the marine vegetation, like the terrestrial, resembles that of our climates the more in proportion as it belongs to more recent formations, and more that of equatorial climates, as it belongs to a more ancient formation. We have not room to notice the other papers of this number of the Journal of the Academy, all of which do credit to that Institution.

19. *New monthly Journal, called The Friend of Mankind;* conducted by Prof. Rafinesque.—It is not to be restricted to any particular subjects, but is to embrace all kinds of useful knowledge, whether in science, literature, or art, and is intended to give them a cheap and popular form. Reviews will be introduced, containing notices of the increase of knowledge afforded by books.

20. *Proposed exchanges by the Franklin Society of Providence, R. I.*—The Franklin Society have procured, by purchase, the extensive collection that belonged to the late Dr. Samuel Robinson, which having a large number of duplicate specimens, will enable them to furnish valuable suites from that vicinity, and Massachusetts, to those who may be desirous of obtaining them in return for others, from different sections of the country.

21. *Destruction of Life by explosions of Steam Boilers.*—Mr. Redfield has given, in the present number, a valuable document on this painful subject. We are glad to find the amount so much less than was stated, on the authority of a correspondent, in a former number of this Journal, (Vol. XIX, p. 3). We shall be ready

to receive from our correspondent any statement in support or modification of his former account. The loss of life on board of steam boats in consequence of running foul of each other, has been considerable, and of course is not included in Mr. Redfield's statement.

The public have a right to demand a prompt and careful investigation of the immediate causes of these dreadful calamities.

22. *Encyclopedia Americana.*—The 6th Vol. of this valuable work has appeared, and is written and compiled in the spirit of its predecessors. It is learned, condensed, perspicuous and practical.

23. *Ohio Canals.*—The fine state of Ohio, with a million of free inhabitants, following the example of New York, has not hesitated to expend millions of dollars upon her canals. By the report of January, 1831, it appears that \$4,131,579$\frac{21}{100}$ had been expended upon the great canal and its branches and auxiliaries; \$554,186, it was supposed, would be requisite to finish the work, exclusive of superintendence and engineering. It is fair to infer that \$5,000,000 will cover the whole, and then the great lakes will be connected with the Ohio river, as well as with the Hudson, and thus (the canal around the falls of the Ohio being finished) there will be an uninterrupted inland water communication between New York and New Orleans, surpassing in extent any thing known elsewhere in the world. In this way Ohio and the contiguous states will enjoy the choice of a market, either at New York or New Orleans; an advantage not too dearly purchased for Ohio, at the average price of \$10,555 per mile on her canals, exclusive of charges of superintendence and engineering. Should the United States continue at peace, and wisely appropriate their superfluous resources to internal improvement, what grand results may be ultimately expected. Baltimore, with its rail road, and Washington city, with its canal, will in a few years connect the Ohio with the Chesapeake; the Delaware, the Susquehanna, and the Ohio, will be joined through the great canals of Pennsylvania; the Alleghanies, although they cannot be levelled, will be readily passed, and a multitude of communications of smaller extent, but some of them of great importance, will facilitate the commercial, social and political interchanges of this country, which interest and policy will conspire to connect in one empire, compact and we trust indissoluble, although so extensive. Would governments avoid war,

how soon would they be able to effect the most desirable improvements, and to augment, an hundred fold, the resources and enjoyments of their subjects! War is madness; it settles nothing as to right, and when its rivers of blood have flowed and its millions have perished, the survivors can adjust their claims only by discussing them in a spirit of conciliation and justice, which they could have better done before they had mutually inflicted the most dreadful sufferings.

24. *Journal of Law.*—This Journal appears in semi-monthly numbers of sixteen pages each.* It is addressed to the People of the United States, and is devoted to the exposition, in popular language, of the philosophy, history, and actual state of law and government in different countries—of our own constitutions, state and national—laws, civil and criminal—judiciary systems and modes of procedure—together with particular essays on those branches of the law, a knowledge of which may be most practically useful to men engaged in active pursuits; as, for instance, the law of corporations, patents, insurance, bills of exchange, and commercial and other contracts, in all their varieties, real estate, with the modes of conveying it, insolvency, wills, descents, intestacy, &c. &c.

Reports of interesting decided cases, biographies of eminent lawyers and others, medical jurisprudence, sketches of the legal, literary and benevolent institutions of various countries, anecdotes, and the various topics of general literature are within the scope of this journal.

Its aim is to afford instruction without tediousness, and amusement without frivolity.

This journal, (useful we cannot doubt to the profession, and not without interest and even amusement to the general reader,) affords another instance of that division of literary and professional labor, which, as in practical arts and business, is necessary to excellence. Theology and medicine have long, in this country, had their appropriate journals, and jurisprudence has, at former periods, called forth several attempts, and if they could not be sustained, it was probably because they were elaborate and voluminous. The present being in fact a newsletter of law, must command a much larger number of readers, and will, we presume, be adequately supported.

* J. Dobson, 108 Chesnut street, Philadelphia; price $1.50 per annum. All agents for the Journal of Health receive subscriptions for this work.

25. *Alum in Mica Slate.*—This fact is of not unfrequent occurrence in this country. A crumbling, half decomposed mica slate, now lies before us, containing beautiful incrustations and masses of plumose alum in fine silky crystals not unlike those of the Island of Milo, (Greece.) We are informed that the rock is found about three feet from the surface of the earth, and the alum appears to be purer, the deeper the digging proceeds.

Some mica slates contain sufficient sulphur to burn blue when laid on a hot shovel,* or coals, and the alum would appear to be formed between the sulphur, becoming sulphuric acid, by the action of the oxygen of air or water, or both, and the alumina of the mica, aided probably by alkali in the same mineral.

If materials of this kind should be found in abundance, they might form the basis of a profitable manufacture.

In the present instance, reference may be had to Mr. Christopher Johnson, of Colchester, Conn., where the rock is found.

Addition to Prof. Johnson's piece on steam.†

On page 310, after "direct ratio of the density," line 7th, insert the following:—It is true that if only one boiler in a range were to become empty and exposed to excessive heat, at the same time, the quantity of steam just calculated, would be, in part, distributed, through the connecting pipe, to the others, at the moment of its production, which would diminish in a measure the pressure in the over heated boiler. It may be said on the other hand, that the over heating of the outer shell will never be confined to the lower arch, nor to a single boiler in a range; and it is evident that the *lower* boilers in a boat must in the cases supposed want *steam room* in proportion as the *upper* want water; and that the connecting pipe could not, as generally constructed, convey away the steam so fast as it would be produced. The boiler which had been most remote from the wharf, has generally sustained the injury, in explosions that have occurred immediately after putting off.

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* In this instance, heat exhales the smell of sulphur, but without flame; most of the sulphur has evidently been acidified.

† Received too late for insertion in its proper place.

POSTSCRIPT.

After the preceding page was in type, we received the following note from the Hon. Stephen Van Rensselaer, with a request that it might appear at the end of the present number, and a compliance is less an act of courtesy than of justice, especially as many of Mr. Eaton's papers have appeared in this Journal;—always, however, (as in the case of other correspondents,) on his own responsibility—for it is stated in the plan of this Journal, prefixed to Vol. I., that "the Editor will not hold himself responsible for the sentiments and opinions advanced by his correspondents."

Gen. Van Rensselaer's Note.

It is stated on page 482 of the last number of the North American Review, that Prof. Amos Eaton had abused the opportunities, furnished by me, of doing good in the cause of geological science. Will you do me the favor to state that I am perfectly satisfied with Prof. Eaton's labors? He has been diligent and faithful in attending to the general duties of his department.

I am not a geologist myself, but I have received assurances from many of our distinguished scientific men, that Prof. Eaton's mass of geological facts has greatly contributed to advance the science in this country, and to awaken the spirit of inquiry on geological subjects. Mr. Jeffries, of Edinburgh, also informed me some time since, that Prof. Buckland, whom the correspondent of the N. A. Review so deservedly compliments, says that Prof. Eaton "*seems both to understand his business, and to have done it carefully.*" May not these assurances be fairly considered as counterbalancing the assertion of the correspondent referred to?

It is to be regretted that the author of the review, whose professed object was to advance the science, did not examine Prof. Eaton's views with a little better spirit, and *point out* and *correct* the supposed errors. Let any serious mistakes be *pointed out*, and *fairly* *proved*, and I will immediately cause a resurvey of the state to be made by other scientific gentlemen.

S. Van Rensselaer.

Albany, June 22d, 1831.

Remarks.—Although we have not always agreed in opinion with our correspondents, and with Prof. Eaton among the rest, we have been satisfied that his valuable labors have contributed very materially to the advancement of geological knowledge in this country, by promoting investigation, and adding largely to the mass of facts, which constitute the true riches of geology. Were the entire crust of the planet fully explored, and the nature and order of its mineral masses, and their contents accurately ascertained, described, and laid down in maps and sections, no one would hesitate to say, that a vast service had been performed, even although no theory, nor any speculation had been devised.

The value of geological research is, therefore, very great, and that of geological theory is certainly much less, although it is highly interesting; theory is constantly fluctuating with the progress of discovery, and until we have discovered all the facts, we cannot be sure that our theories will stand. With respect to theory and nomenclature, there is therefore, room both for fancy and error; but those who, like Mr. Eaton, have labored hard and long, in investigating facts, and like him, have faithfully reported them, according to the best views which they possessed at the time, are entitled to our respect and kindness, although their first sketches may possibly require some correction from subsequent observations of themselves and others. The munificence of Gen. Van Rensselaer in promoting geological knowledge, is, so far as we are informed, without a parallel in any country, and he has been fortunate in the field of geological research, in which he has employed Mr. Eaton, since it is not only fruitful in scientific facts, of great interest, but in substances of prime importance to society; and perhaps we may yet hope that coal will be added to the other mineral riches of this important region, although it may lie at a depth, too great to admit of its being profitably explored.*

Yale College, June 27, 1831.

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* See Mr. Eaton's excellent view of this subject, Vol. XIX. No. I. of this Journal.

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