THE

# REGISTER OF ARTS,

OR A

## COMPENDIOUS VIEW

OF

## SOME OF THE MOST USEFUL

MODERN

## DISCOVERIES AND INVENTIONS.



BY THOMAS GREEN FESSENDEN,

AUTHOR OF THE MODERN PHILOSOPHER, OR TERRIBLE TRACTORATION, &c. &c.

KNOWLEDGE IS POWER............BACON.

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# PREFACE.

THE object of the following work is to present to the American publick useful information in agriculture, and the arts. The editor has selected from every quarter, within the reach of his means, such intelligence as promised to be of particular advantage to the citizens of the United States. He has devoted much time and been at very considerable expense to collect the contents of this volume.

There can be no doubt but that many of the articles which follow in this work will appear to men who have devoted their lives to the arts, and those sciences which are most immediately connected with them, as trite and little worthy of notice. But what might seem to such persons as merely common place information may, perhaps, prove valuable to others, whose time may have been devoted to pursuits of a different nature; and many men who are professed artists or practical agriculturists may not be in possession of great improvements and discoveries, which may have been by the effect as well of accident as science, made by others engaged in the same or similar occupations.

In culling from foreign journals, the editor has confined himself to such papers as promise to be of practical utility in the United States. Much of the matter contained in those of the greatest celebrity in Europe, consists of the speculative opinions of theorizing philosophers, or is local and of little or no importance to the citizens of the United States, A publication of the kind now presented, may, it is hoped, prevent the necessity of purchasing and the labour of exploring bulky and expensive volumes, and supply the ingenious agriculturist, artist, and mechanick, not only with divers processes for facilitating and rendering more productive their labours, but likewise furnish them with useful hints, which may lead to further improvements and inventions.

The editor would have been happy to have presented the publick with further specimens of American ingenuity, on topicks connected with the design of this work, but he generally found a reluctance in those persons who had made any considerable discoveries or improvements in any of the useful arts, to make publick their inventions: alleging, and as the editor believes, very truly, that the patent law of the United States, and the decisions of our courts thereon, as they now stand, do not give sufficient security to the patentee, in the property of his invention. He is therefore induced to divulge no more of the process than what might be deemed absolutely necessary to entitle himself to a patent; and confine the principles of his invention to his own workshop. The editor has understood, however, that exertions have lately been making to give to inventors a more certain, better defined, and more durable property in their inventions, and thus by rewarding ingenuity, to call forth the exertions of the ingenious. Should the veil be thus removed and the editor be allowed the privilege, he hopes in some future publication, which may serve as a continuation of this work, to exhibit to the publick further proofs of the ingenuity and inventive powers of his countrymen.

Philadelphia, May 20, 1808.

# THE

# REGISTER OF ARTS,

## *&c. &c.*

## MACHINE FOR GRINDING COLOURS.

FROM THE TRANSACTIONS OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE.

MR. JAMES RAWLINSON, of Derby, presented a model of this machine to the Society of Arts, for which he received the silver medal and ten guineas. He used the machine for several years, and has found it much more effectual and expeditious in reducing the colours to extreme fineness, than the usual method, and much less injurious to the health of the workmen, who frequently have done as much with it in three hours as they could in twelve with the muller and slab.

The machine consists of a flat cylinder of black marble, sixteen inches and a half in diameter, and four and a half in thickness, with an axle traversing its centre (thus somewhat resembling a common cutler's grindstone.) It is suspended on a similar frame, in a vertical position, and turned round in the same manner by a winch; a concave piece of marble is provided of the same breadth as the circular stone, forming a segment of the same circle one third of the circumference in extent. This, which may be considered as the muller, is fitted into a piece of solid wood of similar shape, one end of which is secured loosely by a hinge, or otherwise to the frame; the other end rising over the circular stone and supported by it, is further pressed down on it by a long spring, bent over from the opposite extremity of the stand, and regulated, as to its pressure by a screw whose end turns against the concave muller; a slight frame of iron in front, moveable on a hinge, by which it is secured to the frame, supports a scraper for taking off the colour, formed of a piece of watch spring, which is turned back out of the way when not in use.

Mr. Rawlinson thinks that the circular grindstones might be made much larger than that he used, to advantage, and that one of two feet diameter would not occasion too much labour for one man to turn it. He computes that in his machine there are seventy square inches of the muller in constant work on the paint, while in the common muller not more than sixteen square inches are usually in contact with the slab. The machine will be found equally serviceable for the colours ground in water as for those prepared with oil, according to Mr. Rawlinson, who highly recommends its use to all colourmen.

Mr. Rawlinson advises to make up the colours in bladders, and to insert a bit of quill or reed in the neck of the bladder, which will thus bind better in tying; and admitting of a secure stopper, will be more cleanly and less wasteful than the usual method of stopping by a nail, and keep the colour more safe from the air.

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## DESCRIPTION OF A WHEEL-DRAG,

FOR PREVENTING ACCIDENTS, WHICH FREQUENTLY HAPPEN TO HORSES. DRAWING LOADED CARTS DOWN STEEP HILLS; BY MR. JOSEPH KNEEBONE, OF MARAZIONE, CORNWALL. WITH A PLATE.

FROM THE TRANSACTIONS OF THE SOCIETY OF ARTS, &c.

A BOUNTY of twenty guineas was given to Mr. Kneebone for this invention.

A letter which accompanied the description of this machine states, that this drag is a safe and effectual method of stopping carts, or other two-wheeled carriages in descending steep hills, so as to take off the great burden from the back of the shaft horse, and to permit the carriage to descend with the greatest safety and ease, even in the most mountainous country, and that within these six months its use has become general, particularly among farmers ; also, that it may be applied to any kind of roads, not being subject to the inconveniences of locking poles, which in rough roads or deep ruts, are very apt to overturn carts, by the sudden resistance they meet with.

By enlarging the wheel, and increasing the length of the shoulders, the drag will become less liable to be choaked with mud, and will adapt itself to hills of little or considerable steepness, which it does very readily by placing itself less or more forward. It does not appear that any great weight is applied to the wheel, and for that reason, wheels of cast iron, with spokes, will answer equally well, are lighter, and less expensive.

It should be shod with iron or steel, on the part on which the greatest pressure is applied, by fixing on it a plate by means of two holes in its bottom, which will always receive a similar piece when it may be wanted, so that the drag is easily kept in good repair.

The letters containing this information were followed by certificates, signed by three farmers and carters, stating, that they had made use of this wheel, by applying it to their carts ; that it is simple and easily applied ; and that it effectually stops two wheeled carriages, in descending steep hills ; taking off the additional weight thrown on the back of the shaft-horse, so as to enable them to convey as much weight down the steepest hill as on a level, and with as much ease to the shaft-horse.

They apply the wheel-drag on the brow of the hill to the near wheel, fastening it to the shaft by a chain, to prevent the wheel from passing over it in case of great obstacles, and they have never observed that deep ruts or loose stones in any manner lessen the advantages which this contrivance is calculated for. Instead of a loaded cart running on the heels of the shaft-horse in descending hills, this drag, by supporting and elevating the wheel, places it on a level, so as to oblige the horse to draw a small burden ; and in some instances it is even necessary to link the chained horse to the drag-wheel side, by which means a weak horse may be placed within the shafts without any danger.

After the cart is descended to the bottom of the hill, the drag is taken off and hung under the cart.

### EXPLANATION OF THE FIGURE.

*(See plate I, Fig. 1.)*

a a a. A piece of wrought iron, curved to the exact form of a cart wheel, with the thickest part at b.

1, 2, 3, 4, are shoulders which keep the wheel within the drag, and should be about four inches high.

c. The wheel made of solid iron, nearly as wide as the drag, and seven inches in diameter; it runs on its axis at *d*, has a strong shoulder, and standing forward, resists the jolts of rough roads.

e. The chain to be fastened to the near shaft, to keep the drag properly under the wheel, which from jerks might be apt to pass over the drag and leave it behind: this is a proper precaution, though seldom wanted, if the drag is well constructed. In the shoulders 1 and 3, are shown holes, by which the drag is hung on hooks, at the under part of the tail of the cart when out of use.

## REMARK BY T. G. F.

This machine, although very simple, may be made very useful in many parts of the United States. It will be obvious to the intelligent farmer, that the whole apparatus, excepting the chain, may be made of tough wood, the parts being of somewhat thicker dimensions than those above described.

# IMPLEMENT

## TO ENABLE SHOEMAKERS TO WORK IN A STANDING POSTURE.

FROM THE TRANSACTIONS OF THE SOCIETY OF ARTS, &C.

FIFTEEN guineas were given to Mr. Thomas Holden, of Fettleworth, Sussex, by the Society of Arts, for contriving this implement.

" It resembles a stand, such as is used for reading desks: at its top is a small block of wood, excavated so as to form a proper bed for the last, and the moulds or instruments, used in making boots, which are kept firm upon it by a stirrup or endless strap.

" This hollow block is joined into another piece (which connects it with the stand) so as to admit of a vertical motion; and it is retained at any angle in this motion, by a circular catch, with notches formed in its side to fasten it on an iron catch projecting from the lower piece. This lower piece is shaped into a small cylinder beneath, which entering into a hole formed for it in the top of the pillar of the stand, permits the hollow block to be moved round about, without stirring the stand; so that by the combination of these two motions, it may be placed in any position.

" Behind the hollow block and on a level with it, a horizontal piece of board is supported by a small pillar, rising from one of the feet of the stand, and secured firm by a brace to the stand itself. This board supports the tools and implements wanted, ready at hand for the workman's use.

" The design of this invention is to obviate the necessity of using that very unwholesome posture in which shoemakers are accustomed to work; which compresses the lungs and bowels in such a manner, as to occcasion consumption, inflammation of the bowels, and a variety of other frightful complaints.

" The efficacy of the alteration of posture, permitted by this instrument, which enables the workman to stand at his work, is very well proved in the case of the inventor of it, who has produced a medical certificate, that he was for many years so afflicted with bowel complaints and piles, that he was under the necessity of leaving off his trade entirely, if he could not contrive to work standing; and that since he has made use of this implement his complaints are entirely removed, and he is so improved in flesh and countenance that he "looks not like the same man;" and for some years he had no occasion for medicine. He has made many hundred pairs of shoes on this stand, and recommends its general use as "the quickest way of closing all the thread work."

The editors of the "Retrospect of Discoveries" make the following, among other observations on this invention.

"This implement might be made still more simple by leaving out the part used to give the hollow block a circular motion, which does not appear necessary, from the facility which the workman has, when standing at it, to place himself instantly at any side of his work he pleases; and it seems therefore it would be full as little, or rather less trouble to him to let the instrument remain unmoved, and turn himself round instead of it, as to stand still while he turned it about.

"A wooden vice of a proper height, fixed to a stake, and secured even by a wedge, if a screw should be deemed expensive, would also hold a last in any position required for the workman.

"These circumstances are mentioned, because the invention is highly valuable, and whatever can tend to render it cheaper, or enable the workman to procure other instruments for this purpose, which chance might render more easy to acquire, or his fancy make more agreeable, must be of use.

"It would be a matter of great humanity to persuade other orders of workmen, as well as shoemakers, to work in postures less injurious to their health than those they are in the habit of using, some of which use them without any apparent reason: for instance taylors, who could full as well perform their work standing or sitting before a table which supported it, as by coiling themselves up into a form equally preposterous and useless, and still more injurious than that used by shoemakers, as it compresses and deranges the vital parts still more, while at the same time it cripples their limbs. But such is the force of custom, that sickness, pain, and ridicule are endured rather than change a useless posture, which nothing but the total absence of chairs and tables can excuse, and which can now serve no purpose but to prove the antiquity of the profession to have preceded the invention of furniture. But as this is a point no one will dispute, it is to be hoped some of them will have sense enough to lay it aside; and that some masters may be induced to provide tables at which men may work either standing or sitting as they choose; who would find their account in this piece of humanity, both in having the work less interrupted by a change of hands, in keeping it more clean, and probably also in other particulars. Much might be added also here, with propriety, as to the humanity of having workshops of all kinds, where many men work together, better ventilated and larger, to improve the health of the workmen, but that it is feared the observations on this subject will be thought already too much extended."

## CHEAP ENGINE FOR RAISING WATER.

FROM A LETTER WRITTEN BY MR. H. SARGEANT, OF WHITEHAVEN (ENGLAND) TO MR. TAYLOR, SECRETARY TO THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS.*

IRTON-HALL, the seat of E. L. Irton, Esq. is situated on an ascent of sixty, or sixty-one feet perpendicular height; at the foot of which, at the distance of about 140 yards from the offices, runs a small stream of water. The object was to raise this for domestick purposes.

To this end a dam was made at a short distance above, so as to cause a fall of about four feet; and the water was brought by a wooden trough, into which was inserted a piece of two inch leaden pipe, a part of which is seen at A. plate I. fig. 2.

The stream of this pipe is so directed as to run into the bucket B. when the bucket is elevated; but so soon as it begins to descend, the stream flows over it, and

* From the Transactions of the Society of Arts, for 1801. A silver medal was given to the inventor. See likewise Nicholson's Journal for May, 1802.

goes to supply the wooden trough or well in which the foot of the forcing pump C, stands.

D is an iron cylinder attached to the pump rod, which passes through it. The cylinder is filled with lead, and weighs about 240 pounds.* This is the power which works the pump, and forces the water through 420 feet of inch pipe from the pump up to the house.

At E is fixed a cord, which, when the bucket comes within four or five inches of its lowest projection, becomes stretched and opens a valve in the bottom of it, through which the water empties itself.

This machine must be so constructed that the bucket end may finish its stroke, when the beam or lever, by which it is suspended, comes to a horizontal position, or a little below it. By this means the lever is virtually lengthened in its descent in the proportion of radius to the cosine of about thirty degrees, or as seven to six nearly, and consequently its power is increased in an equal proportion.

The valve may be opened in the way here described, or by a pin projecting from the bottom.

This pump requires about eighteen gallons of water, in the bucket, to raise the counter-weight, and make a fresh stroke. It makes three strokes in a minute and gives about half a gallon into the cistern. Or, as observed by Mr. Nicholson, in his Journal for May 1802, with a fall of four feet and consumption of eighteen gallons, it raises half a gallon through sixty feet. That is to say, 12 parts of water raise 5 parts.† Its rate is about one eighth part of one man's work; and it throws up 24 hogsheads in a day. It may be stopped to save wear, by merely casting off the string of the bucket valve.

The only artists employed, except the plumber, were a country blacksmith and carpenter; and the whole cost, exclusive of the pump and pipes did not amount to five pounds sterling.

* This cylinder might, for the sake of economy, be made of wood, and filled with gravel or sand, provided the weight were sufficient.

† Accurately, allowing the height to be 64 feet, 72 parts of water will raise 30.5. T. G. F.

## REMARKS BY T. G. F.

The simplicity of construction, and the cheapness of this machine must render it worthy of attention, not only for raising water for domestick purposes, but in many cases it might be turned to account in agriculture by watering upland fields, gardens, &c.

This engine, although the most simple of any which has fallen within our notice exhibits but one of a great variety of methods which engineers have adopted for raising a part of a stream of water above its level by force of its fall. Machines for accomplishing the same object, but of a more complicated construction, are described in philosophical Journals. The invention of Mr. Close published in Nicholson's Philosophical Journal for January 1802, and analysed by Mr. Nicholson, in his Journal for February, the same year, of a hydraulick apparatus, acting by a syphon, Mr. Trevithack's powerful engine for raising water by the pressure of a column, enclosed in a pipe described in Nicholson's Journal for March 1802, improvements on the hydraulick engine of Schemnitz, and that of Mr. Goodwyn by Mr. John Whitley Boswell, likewise described in Mr. Nicholson's Journal, have all the same object. But, after having attentively perused these, I am of opinion that the machine, here described, will be found to possess much the greatest general utility.

Since writing the above, I have seen a corroboration of my opinion relative to the utility of this invention, in a work published in England, with the title of "Retrospect of Arts," p. 318-19.

## APPARATUS FOR DRIVING COPPER BOLTS INTO SHIPS.

BY MR. RICHARD PHILIPS.

FROM THE TRANSACTIONS OF THE SOCIETY OF ARTS, &c. 1801.

THE Society adjudged a reward of forty guineas to the inventor.

This instrument consists of a hollow tube, formed from separate pieces of cast iron, which are placed upon the heads of each other, and firmly held thereto by iron circles or rings over the joints of the tubes. The lowest ring is pointed, to keep the tube steady upon the wood. The bolt being entered into the end of the hole bored in the wood of the ship, and completely covered by the iron tube, is driven forward within the cylinder, by an iron or steel punch, placed against the head of the bolt, which punch is struck by a mall; and as the bolt goes further into the wood, parts of the tubes are unscrewed and taken off, till the bolt is driven home into its place up to the head. The tubes are about five inches in circumference, and will admit a bolt of seven eighths of an inch in diameter.

### REMARK BY T. G. F.

We need not suggest to the ingenious mechanick the variations of which this simple contrivance is susceptible, so as to be applicable to the purpose of driving spikes, long nails, &c. In many instances a simple iron tube without joints, of a diameter merely sufficient to admit the head of the spike or nail, with a punch of a due size, will be found adequate to the purpose, and will enable the workmen to drive the spike or nail much tighter than could otherwise be done.

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## APPARATUS FOR AQUA TINTA ENGRAVING.

DESCRIPTION OF AN APPARATUS TO PREVENT THE INCONVENIENCE WHICH ARTISTS EXPERIENCE FROM THE FUMES IN AQUA TINTA ENGRAVING. PHIL. MAG. NO. 90.

IN the art of aqua tinta engraving, the artists experience much inconvenience from the quantity of fumes liberated by the action of the acid upon the copper.

To remedy this the following arrangement has been proposed by MR. CORNELIUS VARLEY. Get a frame made of any kind of wood, three or four inches deep, covered with a plate of glass and open at one side. Let the side opposite to this have a round opening communicating by means of a common iron pipe, with the ash pit of any little stove or other fire place, shut up from all other access of air but what must pass through the pipe. Any fumes arising from such a frame will be carried into the iron pipe by the current of air required to maintain combustion in the stove; and will by this means be carried up the chimney, wherever it may be, instead of being allowed to fly about the apartment. The pipe may be very conveniently used, by carrying it down through the table to the floor, and thence along to the chimney, wherever it may be; and when the frame is not wanted, the pipe at any one of the joinings may be made to answer the purpose of a hinge, by which to turn up the frame against the wall, where it may be secured while out of use, by a button, or any similar contrivance.

## REMARK BY T. G. F.

This invention, from its simplicity and obvious utility, promises to be generally adopted. A plan in some degree similar, but more complicated, was recommended by M. Boulord, of Lyons, architect, for preserving the health of those who are employed in grinding colours. It is described in the fifth volume of the Repertory of Arts.

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## ON BLASTING ROCKS.

IMPROVEMENT WHEREBY THE DANGER OF ACCIDENTAL EXPLOSION, IN BLASTING ROCKS IS, IN A GREAT MEASURE OBVIATED. PHIL. JOURN. NO. 47.

THE principal danger attendant on blasting does not consist in stemming upon the charge of powder, but in the subsequent operation of drawing the iron rod, called the pricker, which makes the channel for the priming straw; for it frequently happens that the friction of the lowest part of the pricker against the rock fires the powder, and an explosion is produced which places the life of the workman in the utmost danger.

To obviate this danger, Mr. Fisher, of Dalton, proposes an improvement, which consists in the use of a copper rod, or pricker instead of one of iron. Upwards of three years have elapsed since this improvement was adopted in a very extensive work, where accidents were frequent before, and as no accidental explosion has since taken place at the end of stemming, Mr. F. considers the invention as almost infallible.

Mr. Fisher thinks that the use of sand in blasting is preferable in deep holes; but that it is more liable to be blown out than stemming. He also considers it as the most advantageous mode of working in driving levels, and blasting in firm rock, to use strong charges of powder, that the stone may be sufficiently broken by the explosion to be removed without much assistance from the hammer, the pick, or the lever.

The following article suggests another important improvement in blasting rocks.

Account of a method of increasing the effects of gunpowder; showing also the necessity of certain precautions in loading fire arms. From the Journal des Sciences et des Arts.

We have been informed by Mr. Humbold, counsellor of the mines to the king of Prussia, that the effects of gunpowder in mines, &c. have been found to be very much increased by leaving a considerable space between the powder and the wadding. He also informs us, that the person who made this discovery was led to it by the consideration of a fact well known, but which cannot be too often published; namely, that a musket, fowling piece, &c. is very apt to burst, if the wad is not rammed down close to the powder.*

Without undertaking to show how far these circumstances are analagous to each other, we think it may not be amiss to mention two other facts of a nature similar to the above.

First, If a bomb or shell is only half filled with gun powder, it breaks into a great number of pieces; where-

* Hence it is obvious, that in loading a screw-barrel pistol, care should be taken that the cavity for the powder be entirely filled with it, so as to leave no space between the powder and ball.

as, if it is quite filled, it merely separates into two or three pieces, which are thrown to a very great distance.

Secondly, If a trunk of a tree is charged with gunpowder for the purpose of splitting it, and the wadding is rammed down very hard upon the powder, in that case, the wadding is only driven out, and the tree remains entire; but if, instead of ramming the wadding close to the powder, a certain space is left between them, the effects of the powder are then such as to tear the tree asunder.

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## APPARATUS FOR SPLITTING LOGS OF WOOD.

A SIMPLE APPARATUS FOR BREAKING UP LOGS OF WOOD, BY THE EXPLOSION OF GUNPOWDER. BY MR. RICHARD KNIGHT. TRANS. SOC. ARTS, 1802.

THIS apparatus consists of a gouge and augur for boring a hole into the wood to receive the powder. An iron or steel rending or blasting screw, which is made use of instead of a plug or stemming to confine the powder. The handle of this screw should be divided into two forks or prongs in such manner as to admit a lever for the purpose of winding it into the wood. The dimensions of the screw should be such that it may not too easily be wrought into the hole, previously made by the augur. Through the center of the screw is a small hole, to which a priming wire is fitted for the purpose of occasionally clearing the hole, and introducing a quick match. This hole should be as small as is convenient to prevent the escape of the ignited powder. The match may be made of cotton or twine thread, steeped in a solution of saltpetre. A straw, however, filled with powder, in the manner in which the miners use it answers very well. A leather thong may be attached to the lever, in order to fasten it, occasionally, to the screw to prevent the loss of the latter, in case it should be thrown out when the log is burst open; a circumstance which, the inventor says does not often occur, as when the wood was sound he has always found the screw left fixed in one side of the divided mass. Should this not be thought a sufficient security for the screw it may be fastened by a chain or rope to any heavy or fixed object.

## REMARK BY T. G. F.

The effect of the powder would be greatly increased by leaving a considerable space between the screw and the charge as is apparent from the preceding article.

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# MACHINE FOR ROOTING UP THE STUMPS OF TREES.

BY CITIZEN SAINT VICTOR, MEMBER OF THE SOCIETY OF AGRICULTURE FOR THE DEPARTMENT OF THE SEINE.*

THE machine contrived by citizen VICTOR, for the purpose of eradicating stumps of trees, consists of a box of forged iron, about two feet eight inches long, one inch thick towards the handle, and two inches towards the breech or platform.

The platform is circular and fourteen inches in diameter.

This platform serves as the base of the chamber, or furnace of the mine, which is three inches in diameter, and three inches eight lines in the length of its bore.

The stopper or tompion which serves as a plug to the mine is of the same diameter, to enter within after a slight paper or wadding. It is attached by a chain to the gun or mortar, which last is eight is eight inches in diameter. About two inches above is added a small touch-hole or pan. The hole is directed in an angle of forty-five degrees, and is primed with powder to communicate with the charge with which the chamber is filled up to the stopper.

This engine may be cast even with more facility in brass or bronze, and in this case, it must be a little thicker in all its dimensions, in order to afford a resistance equal to that of forged iron.

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* Bibliotheque Phys. Economique, de Sonini, No. 1. See likewise Nich. Jour. April 1803.

### USE OF THE MACHINE.

When the machine is charged with powder, a small excavation is made with a pick-axe, beneath the centre of the stump. The machine is then placed in it, so that the plug immediately touches the wood. Care must be taken to fill all the vacancies, either with stones, or pieces of wood, more especially beneath the platform of the machine, in order that the explosion of the powder may have its full effect on the stump, of which if necessary the principal roots should be cut, if any appear on the surface of the ground near the stump, that is to be eradicated.

When the machine is firmly fixed to its place, the priming is put to the pan, a slow match applied, the length of which is sufficient to allow time to retire a proper distance from the explosion.

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## PATENT FOR TANNING LEATHER.

THE SUBSTANCE OF A SPECIFICATION OF A PATENT GRANTED TO ANTHONY FAY, FOR IMPROVEMENTS IN THE ART OF TANNING LEATHER. REPERTORY OF ARTS, VOL. IV.

THE bark should be ground in the usual way, allowing two or three gallons of water (the exact quantity not being material) for every pound of bark, and the decoction repeated, till the substance becomes tasteless. This extract, by mixing with water may be reduced, and thus a great saving made in the carriage. The extract, or ooze, will render the offal of the pelts, hitherto of little value, almost as good as any part of the pelt, and will give the leather a compactness, grain, strength and additional weight, superiour to the methods now in use, and on that account is peculiarly useful in tanning horse and seal-skins, and all other pelts of a loose and spongy nature. Besides, in proportion to the strength of the ooze made from the above extract, it will accelerate the tanning of leather, doing it in less than one half the time hitherto used, and with less than half the quantity of bark hitherto spent in the operation; as in the common way a considerable proportion of the qualities essential for tanning, leather remain unspent in the refuse of bark, commonly called dry tan, but it must be observed that such oozes must be used perfectly cold.

With respect to the construction of the tan-yards, this patentee advises that they should be covered, and a crane placed in the centre of the building, whose jib or arm should be long enough to extend round the whole area of the building. The standard of the crane should have an axis at its lower extremity, and another a few inches above that part of the jib which is inserted in the standard, so as to make a revolution round its own axis. The block through which the pully passes should have a brass sheeve, which should have one or more friction wheels or castors, placed between the centre and the axis on which it turns. The block containing the above sheeve should be so made as to pass freely backwards and forwards on castors along the jib or arm of the crane, from one extremity to the other, and two small brass pulleys, one at each extremity of the jib, and a small cord fastened to the block, passing through these pulleys, will move the block at pleasure. A wheel or wheels near the lower part of the crane's standard should be placed in the common method. In very extensive yards more cranes may be erected.

The patentee recommends making the pits circular, and placing a wheel in each, of the following form: Suppose the two wheels of a carriage, with their axis were placed horizontally in the pit, the lower extremity of the axis of such length as to keep the sweep of the lower wheel six inches from the bottom of the pit. A fan of twigs, equal in length to the semi-diameter or spoke of the wheel should be fastened to one of the lowest semi-diameters, so as to sweep the bottom of the pit at every revolution of the wheel. The diameter of this wheel should be eight inches shorter than that of the pit, so that the circumference of the wheel should be four inches within the inner circumference of the pit. The pelts should be placed on the semi-diameters or spokes of the wheel, either longitudinally or cross-way, the spoke passing under the middle of the pelt, and so on round the wheel, fastening the lower part of the pelts thus placed, answering in situation to the upper spokes, so that there may be little, if any contact. The upper circumference of the wheel should be furnished with cogs, answering to the cogs of a small pinion wheel placed on the side of the pit, which may be turned by a winch, so as to move the wheel in the pit; or it may be set in motion by a screw placed vertically on the side of the pit, making the cogs bevil so as to suit the hollow of the screw. The depth and diameter of the pit need not be defined, as every tanner will make them to suit his own convenience. The wheel should be so placed on its axis as to suit the diameter of the pit. There should be fixed at the upper extremity of the axis of the wheel a strong iron ring, which being hooked by the crane, will raise and lower the wheel and its contents. By these means the ooze may be put in motion as often as the tanner pleases, which will much accelerate the process.

The circular pits and wheels should be placed in circular lines around the corner and not sunken in the earth, but elevated some feet above its surface, and so placed like the seats of galleries, one above the other, that they may be discharged into each other by a syphon; and each pit should be furnished with a cock at the bottom, to draw off the ooze.

The covering of the tanyard will prevent the weakening of the ooze by rain, snow, &c. and it will be found better to have the pits close covered. In the pits hitherto used, it will be found a great advantage to frame the pelts, so that the leather may appear as the canvas does in a window blind; and place them so as to touch each other as little as possible, whether placed horizontally, vertically, or obliquely. These may be raised or lowered by the crane as above described.—As no bark or dry tan will be brought into tanyards of this construction, much room will be saved. The *caput mortuum*, or wood, which remains after the essence is extracted from the bark, will be more than sufficient, as fuel, for making the decoction.

In addition to the above, it may be well to mention the method employed by a Mr. Marton (the specification of whose patent for improvement in the art of tanning, may be found in the Repertory of Arts, Vol. II.) for preparing the skins for the process of tanning.

Mr. Martin places a boiler of convenient size near a reservoir of water, with a pipe near the edge of the boiler, to convey the warm water into a tub or vat, placed rather higher than the vats in which it is intended to place the raw goods and those working out of the lime, so that the first may empty itself into the second and third vats.—These vats have false bottoms for drawing off the sedement. The first vat is not intended for goods, but merely for regulating the warmth of the water.

The application of warm water will purify the hides and revive those that have become dry, and expedite the process of tanning by expanding the pores for the reception of the ooze, &c. They may, however, be previously washed in cold water, for the purpose of cleaning them from the external blood and filth.

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## OBSERVATIONS ON THE WEATHER.

### GENERAL OBSERVATIONS ON THE CAUSES WHICH INFLUENCE THE WEATHER IN ENGLAND, AND THE POPULAR METHODS OF JUDGING OF THE WEATHER. BY JAMES COOPER, ESQ.

THE remarks contained in the abovementioned tract, although particularly adapted to the climate and local situation of Great Britain, will not be found to be without their use in America. Indeed most of the observations contained in the following abstract are applicable to almost any part of the world ; and a knowledge of those meteorological phenomona which may be peculiar to Great Britain, will be servicable to the American philosopher, by enlarging his acquaintance with the general laws of nature, and supplying him with facts from which by analogy may be drawn useful and pertinent inferences.

Our author commences his observations by remarking on the great utility of philosophical instruments in forming a judgment of the weather. The barometer, the thermometer, the hydrometer and the electrometer, will generally give us timely notice of any material alteration in the atmosphere. But besides employing these instruments, he recommends attention to the common remarks of the peasantry, and those whose occupation requires them to live much in the open air : Such as a rainbow in the morning is the shepherd's warning ; but a rainbow at night is the shepherd's delight.

This prognostick is explained by showing that the clouds to the westward are saturated with moisture, and if the wind is from that quarter they will probably produce rain. But when the sun sets clear, and the clouds to the eastward are moist, it proves that the wet clouds have past, with a westerly wind, and fair weather will be the consequence.

The weather generally clears either at noon or at sun set. The sun, when advancing to the meridian, dries and clears the air, and consequently the rain is like to cease at that turn. But if there should be so much water in solution in the atmosphere, that the heat of the sun is insufficient to produce that effect, the rain will probably continue several hours longer.

Violent winds generally abate towards sunset. Wind is a current of air put in motion by the rarefaction of the atmosphere in some particular place. As the sun declines the rarefaction diminishes. This observation applies rather to the temperate than the torrid zone, and in whirlwinds and tornadoes the contrary may be the case.

When the wind follows the sun it is generally attended with fair weather. Such wind is rarely more than a moderate breeze, and shows that no point of extraordinary rarefaction is near. This always happens in summer, but seldom when the sun's meridian altitude is less than 40 degrees.

A storm generally succeeds a calm. During a calm the air becomes rarefied and expanded by the heat of the sun, and the cold air rushes forward to supply the equilibrium.

For this reason the barometer falls suddenly, while the air is expanded before the gale of wind, and gradually rises as the condensed air flows in.

Showers are in summer however, sometimes denoted by an extraordinary fall of the barometer. But in spring and autumn such fall indicates principally violent wind.

On these principles we may account for the rise and fall of the barometer in different zones. In the torrid zone, particularly at St. Helena, and the islands of the Pacifick Ocean, it seldom varies more than three tenths; at Madras, about five tenths; in the south of Europe, one inch and two tenths; in England, two inches and a half, and in Petersburgh, three inches and four tenths. In the two first, the temperature of the atmosphere is not subject to much variation for condensation. In the other places the atmosphere may be sometimes suddenly condensed by currents of cold air from the north; the greatest change taking place on the continent, where, in the summer, the weather is as hot as within the tropicks;

and in the winter, the thermometer for many weeks is below the freezing point.

The words engraven on the barometer serve rather to mislead than inform ; for the changes of weather depend rather on the rising and falling of the barometer, than on its remaining at any particular height. When the mercury is at fair, or at 30 degrees, and the surface is concave, beginning to descend, it often rains ; on the contrary, when the mercury is at 29 degrees, opposite to rain, when the surface is convex, beginning to rise, fair weather may be expected. The want of attention to these circumstances is the principal cause why farmers have not sufficient confidence in this instrument.

Besides, *cæteris paribus*, the mercury is higher in cold than in warm weather, and commonly early in the morning or late in the evening than at noon, the atmosphere being condensed by the cold of the night, and rarefied by the heat of the day.

The following observations, by Mr. Patrick, seem confirmed by experience :

1. The rising of the mercury presages, in general, fair weather, and its falling, foul weather, as rain, snow, high winds and storms.

2. In very hot weather, the fall of the mercury indicates thunder.

3. In winter, the rising presages frost ; and in frosty weather, if the mercury falls three or four divisions, there will certainly follow a thaw ; but in a continued frost, if the mercury rise, it will certainly snow.

4. When foul weather happens soon after the falling of the mercury, expect but little of it; and on the contrary, expect but little fair weather, when it proves fair shortly after the mercury has risen.

5. In foul weather, when the mercury rises much and high, and so continues for two or three days before the foul weather is quite over, then expect a continuance of fair weather to follow.

6. In fair weather, when the mercury falls much and low, and thus continues for two or three days before the rain comes, then expect a great deal of rain, and probably high winds.

7. The unsettled motion of the mercury denotes uncertain and changeable weather.

But to these remarks may be added, that when the barometer falls suddenly two or three tenths, without any material alteration in the thermometer, and the hygrometer is not much turned towards moist, a violent gale of wind may be expected. When the hygrometer inclines far towards moist, with only a trifling descent in the barometer, it denotes a passing shower and a little wind, and when the barometer falls considerably, and the hygrometer turns much towards moist, the thermometer remaining stationary, and rather inclined to rise than fall, both violent wind and rain are likely to follow in the course of a few hours.

## GENERAL OR COMMON PROGNOSTICKS OF THE WEATHER.

Among these we may reckon such as are derived from birds, beasts, insects, reptiles and plants, to which might be added great part of the wood-work in houses, as doors, windows, window-shutters, &c.

Birds in general retain in the quill-part of their feathers a quantity of oil, which, when they feel an extraordinary degree of moisture in the atmosphere, they express by means of their bills, and distribute it over their feathers, to secure their bodies against the effects of an approaching shower.

Swallows in pursuit of flies and insects, on which they prey, sweep near the earth in wet weather; and in dry weather, from the same cause, they fly much higher.

Domestick animals, as cows and sheep, but particularly the latter, on the approach of rain, feed with great avidity in the open field, and retire near the folds and hedges as soon as they are satisfied. In fine weather, they graze and lounge about, eating and resting with apparent indifference.

The pimpernel, commonly called peep-a-day, or shepherd's weather glass, closes its leaves before rain; and the dandelion is much affected by moisture.

All wood, even the hardest and most solid, swells in moist weather. The vapours insinuate themselves into trees, and also into the wood-work of houses.

Insects and reptiles of all kinds seek or avoid rain, according to their respective habits, by these means giving notice of every change of the weather.

It is a well known fact, that before rain, particularly in summer, a strong smell is perceived from drains and common sewers, as well as from every other body emitting a great quantity of effluvia. During fair weather, even in the summer, the atmosphere readily absorbs all the vapours and exhalations from the earth, until it is completely saturated, and consequently the effluvia from the bodies which emit them will then be confined, and ascend in a small compass, like the smoke of a chimney in dry weather, almost perpendicularly ; but when the air is saturated with moisture, and becomes rarefied and expanded, as it always does before rain, the volume of air, containing the effluvia, will be extended horizontally, and diverge from their different bodies as from a centre, and will be sensibly perceived on all sides, but will, of course, be most perceptible on that to which the current of air or wind moves.

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## METHOD OF EXTINGUISHING FIRE.

EXTRACTED FROM A LETTER FROM M. VAN MARUM TO MR. BERTHOLLET. NICH. JOUR. VOL. V. P. 103.

"I TOOK two casks, which had been full of pitch, and of which the inside was yet well covered with that inflammable substance; the heads of these were taken out, and in order to assist the operation of combustion, I gave them a conical shape, placing the larger aperture of twenty inches diameter uppermost, the other of sixteen inches diameter below, mounted on a three legged stand, a few inches from the ground, so that the fire might be kept as brisk as possible by the free current of air passing through the cask. I covered the inside of each cask with a fresh coat of pitch, and having placed shavings of wood in each, I lighted them, one after the other I began to extinguish this fire when it was at its height. For this purpose I made use of an iron ladle capable of holding two ounces of water, and provided with a very long handle, being kept at the distance of four or five feet by the volume of the fire. I carefully poured the water from this ladle in very small streams along the inside of the cask, placing the ladle on the edge of the cask, and moving it gradually along the edge as the flames ceased. In this way the first ladleful of water extinguished nearly one half of the fire, and what remained was effectually put out by a ladlefull and in the same manner. The striking success of this experiment induced me to repeat it in the presence of many persons, and with care and attention in the application and management of water, I have more than once succeeded in extinguishing a highly ignited cask with a single ladle-full, of two ounces, of water."

Mr. Van Marum in explaining the theory which is developed by this experiment says that, "when a small quantity of water is thrown upon a highly ignited body, part of that water is instantly converted into steam, which rising from the surface of the burning body, prevents the contact of the atmospherick air, and by that means puts out the flame, which cannot appear again while the production of the steam is continued."

"According to these experiments," he continues, "it appears that the art of extinguishing a violent fire with a small quantity of water consists in this: that the water be thrown on that part of the fire which is the most violent; so that the quantity of steam, produced, which suppresses the flame may be the greatest possible: that water be continued to be thrown in the neighbouring inflamed parts, as soon as the fire has ceased in that in which the operation was begun, and that all the burning parts be visited in this way as soon as possible. By thus following the flames regularly with streams of water, they may be every where suppressed before the part on which the operation was begun shall have entirely lost, by evaporation, the water with which it was moistened; this is often necessary to prevent the parts from breaking out afresh; for on the principles above mentioned, a burning body of which the flames are suppressed cannot be again in flames until the water thrown on it be totally evaporated."

Mr. Van Marum then relates experiments made on a larger scale, one of which we will transcribe from the account given of it by Von Zach a celebrated German astronomer.

Doctor Van Marum being at Gotha, in the course of a literary journey, which he was making in Germany in 1793, the duke of Gotha well known as an amateur of the physical and mathematical sciences, signified his desire to see on a large scale, that experiment of extinguishing fires, the effect of which M. Van Marum had shown him, in extinguishing a pitched cask, set on fire, with a small ladle of water. He caused a building to be constructed under M. Van Marum's direction, in the dutchess's garden, of equal dimensions in all respects with that used for the same experiment at Harlaem, which was 24 feet long, 20 feet wide, and 14 feet high. It had two doors on the north east side, and two window-like openings on the north-west side ; the top was left entirely open to give the flames free vent; the inside of this receptacle was plastered with pitch, and afterwards covered with straw mats, on which melted pitch had been poured. To the bottom of these mats cotton wicks, soaked in spirits of turpentine, were suspended, that so the building might be every where on fire at the same time. In this state the fire excited by the wind, was soon so violent, that the flames with thick clouds of smoke, were carried several feet above the opening of the roof, and so fiercely, that the spectators assembled about the building quickly drew back; many were of opinion that it would not be possible to extinguish it, but that the building must be reduced to ashes. When the straw mats were intirely consumed, the interiour wood work of the building was soon on fire in every part. The most unfavourable circumstances attended this experiment; for the wind drove the flames directly through the doors on the north-east side, by which it had been intended to introduce the streams of water to extinguish them: but notwithstanding this, Mr. Van Marum placed a small portable pump or engine before the door in that part of the north east side of the building nearest to the south east side; without regarding the apprehensions of his assistants, he set it in action, and placing himself before this door, as near as the intense heat of the fire would admit, he directed the streams of water first towards the south east side, and as near the door as possible, and continued until the flames were extinguished on the side, and sprinkled with water in the same direction; after which the water was directed along the south west side and afterwards the north east, so that in a few minutes the flames were got under, and the burning partitions were extinguished. After this the pump was placed before one of the openings in the north west side. He also very soon extinguished the north west side; and lastly coming to the centre of the building, where the fire appeared here and there in the chinks of the boards and the holes left by the nails, breaking out at intervals in small flashes, he entirely extinguished them and thus perfectly subdued this violent fire. It was estimated by several of the spectators, that the fire was extinguished at most in three minutes from the commencement of the action of the pumps to the time when the wood just remained burning, and broke out afresh in some places; these renewals were however so inconsiderable, that the burning parts were quenched by means of some wet rags fastened to a stick. Before setting the pump to work, its reservoir was filled with four buckets of water; but in carrying it to the first window of the building, and from thence to the middle of it, near a bucket full was spilt; so that it may be positively affirmed, that this violent fire was extinguished with three buckets of water excluding that which was afterwards used to quench those parts of the building which remained red. It was easily observed, when the flame was out, that not only the straw mats were burned, but the entire wood work of the building had been on fire, insomuch that the smallest part of wood could not be found in the inside of the building which had not been more or less severely burnt. The north-east side in particular, against which the wind drove the flames with the utmost violence was entirely charred."

Mr. Van Zach further states that the flames and smoke rendered access to the building with the pump very difficult.—That nothing but the courageous example of M. Van Marum himself, in leading his assistants, and directing the operations of the pump could have prevailed on them to have faced the danger, which they considered as very dreadful.

Mr. Van Zach continues, "the result of the foregoing fact is, that in applying the method of extinguishing fire, the circumstances to be observed are these, that to extinguish the most violent fire, it is only necessary to wet the surface of the burning matter in the part where the flames are seen, and that for this purpose only a small quantity of water is needful, if the parts be wetted in the proper manner. In operations of this kind, therefore, particular attention must be paid to throwing the water in such a way, that the entire surface of the burning part shall be wetted and extinguished, and that in such a way that an extinguished part shall never be left between two others which are in flames; for if attention be not paid to this, the heat of the flames burning here and there will quickly change the water with which the part has been wetted into steam, and the whole will again take fire. In order then, to extinguish a fire in all cases, no more water need be thrown on the burning part than is needful to wet its surface; and this I conceive to be all that is requisite to extinguish a fire, whatever may be the circumstances of its origin."

## REMARKS BY T. G. F.

I have frequently taken notice of what appeared to me to be a bad mode of conducting the engines, in cases of fire in London, New York, and Philadelphia. The water is generally thrown into the air, so as to be converted into steam, or very small drops, and thus but a small portion of it, reaches the burning part, the source or fountain of flame. Steam, or even small drops of water, has a tendency to increase a violent fire. Perhaps this is occasioned by the conversion of the latent heat which water contains into sensible heat, or in some cases by the reduction of the water to its component parts, hydrogen and oxygen; the former of which is a highly inflammable substance, and the latter the supporter of combustion. Thus a shower of rain is said to increase the rage of a volcano, and a few drops of water accidentally percolating into the midst of a furnace, when in blast, has caused most violent explosions.

That water, when converted into steam, has a capacity of increasing flame, would appear from the operation of the hydraulick bellows, invented by Mr. Hornblower, and described in Nicholson's Journal, for March, 1802. In this machine, the air which gives the blast, is forced through water, and the inventor says that there existed a striking difference between the effect of this bellows and a common leathered 30 inch bellows in the same shop. The leathered bellows threw considerably more air into the fire, and its nozzle, compared to the hydraulick bellows, was as 73 to 60 in diameter, *but it did not produce so great an effect in bringing on the heat*, and the voice of the former was so great as to almost drown that of the common one.

Neither Mr. Nicholson, nor his correspondent, Mr. Hornblower, attempts to explain the cause of this phenomenon. But may we not conjecture that the air, from the hydraulick bellows, being forced through a body of water, contained a portion of it in solution, or in the form of steam, and that the heat of the water thus held in solution was converted into sensible heat, in the forge, and thus became a species of fuel, as well as an assistant or stimulus to the combustion.

This hypothesis is corroborated by a fact stated in the Philosophical Journal, No. 45. By this it appears that the steam of an engine, after work, was thrown into a chimney; that it had the effect to render the smoke invisible, and became itself immediately so transparent as not to be distinguished. When the smoke was shut off, the steam became visible, and when the steam was shut off the smoke became visible. But what perhaps applies to our hypothesis, the *draught of the chimney was found to be increased by the admission of the steam into the flue.*

This increase of the draught of the chimney was doubtless the consequence of an increase of heat, occasioned by what I will venture to call the combustion of the steam.*

If these premises are correct, it would appear that water in small drops, like dew, or in the form of mist or steam, increases the effect of a strong fire, from the same principles that a shower increases the flame of a volcano; and that in extinguishing a fire, it ought to be applied directly to the surface of the burning part, and not impelled or dropped through such a column of flame or calorick as to be converted into steam, and in that state rather excite than extinguish the cumbustion.

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## PROCESS FOR WATERING HEMP.

PROCESS FOR WATERING HEMP, IN TWO HOURS, BY M. BRALLE, BIB. PHYS. ECON.

GREEN soap (savon verd) 67 grams (12 oz.) is to be added to 110 kilograms (220lb.) water, boiling hot; when the soap is dissolved, 11 kilograms (22 lb.) of hemp are to be immersed, so as to be entirely covered by the liquor, the vessel closed, the fire put out, and the hemp left to macerate for two hours: a smaller portion of soap may do, but the above was the proportion used by M.

* Might not the steam of an engine, after having performed its office in giving motion to the piston, be brought into the furnace, and thus increase the heat.

Bralle, in his publick experiment: for a complete steeping it may be as 1 to 48 of the hemp, and 650 water.

Several steepings may be made in succession, care being taken to add soap each time, to replace what has been absorbed, and to heat the water to the former temperature. The same water may be employed for fifteen days continually.

When the bundles of hemp are taken out, they are covered with straw, that they may cool gradually, without losing their humidity. Next day they are to be spread on a floor, the bands shifted, and a heavy roller passed over them, after which the hemp separates easily from the reed, by beating. The hemp thus separated, is spread on the grass, and turned, and after five days removed to the warehouse. In steeping the hemp, the bundles should be kept in a vertical position, as the operation is found to succeed better so than when they are horizontal.

The advantages of this method are, 1st, The superiour speed of the process to that in common use; 2nd, Its being practicable at all seasons; 3d, Its not being injurious to health, or producing any bad smell; 4th, A saving of expense, when a proper apparatus is used; 5th, A superiour quality of the hemp so prepared, and less waste produced, so that nearly a fourth more hemp is obtained from the same raw materials; 6th, The extending the culture of hemp to all situations, which can now be carried on only in the vicinity of running water.

A very good apparatus, for the process, is formed by a boiler, and wooden tubs, with covers for steeping vessels.

## REMARKS BY T. G. F.

A process in some measure similar to the above described, would, probably, save the trouble and expense of water-rotting flax. Lie made of wood-ashes would, perhaps, answer the purpose of water impregnated with soap, as mentioned above. Flax, as well as hemp, macerated in this way, would be likely to exhibit a firmer fibre than that which is prepared in the usual manner, and might, we believe, be allowed to stand longer in the field, for the purpose of obtaining the seed. The flax may be macerated in tubs, or half-hogsheads, heated by steam, introduced by a metal pipe, from a covered kettle, or boiler, in the manner mentioned by Count Rumford.

# PURIFICATION OF FISH-OIL,

EXTRACTED FROM A COMMUNICATION TO THE SOCIETY OF ARTS, AND PUBLISHED IN NICHOLSON'S JOURNAL, VOL. V. p. 5.

## PROCESS THE FIRST.

FOR purifying fish-oil, in a moderate degree, and at a very little expense.

Take an ounce of chalk in powder, and half an ounce of lime, slacked by exposure to the air; put them into a gallon of stinking oil, and having mixed them well together by stirring, add half a pint of water, and mix that also with them by the same means. When they have stood an hour or two, repeat the stirring, and continue the same treatment at different intervals for two or three days; after which superadd a pint and a half of water, in which an ounce of salt had been dissolved, and mix them as the other ingredients, repeating the stirring as before for a day or two. Let the whole stand at rest, and the water will sink below the oil, and the chalk subside in it to the bottom of the vessel. The oil will become clear, be of a lighter colour, and have considerably less smell, but will not be purified in a manner equal to what is effected by the other processes below given; though as this is done at the expense of only one ounce of salt, it may be practised advantageously for many purposes, especially as a preparation for the next method, the operation will be thereby facilitated.

## PROCESS THE SECOND.

To purify to a great degree, fish-oil without heat.

Take a gallon of crude stinking oil, or rather such as has been prepared as abovementioned, and add to it an ounce of powdered chalk; stir them well together several times, as in the preceding process; and after they have been mixed some hours or a whole day, add an ounce of pearl ashes, dissolved in four ounces of water, and repeat the stirring as before. After they have been so treated for some hours, put in a pint of water in which two ounces of salt are dissolved, and proceed as before: the oil and brine will separate on standing some days, and the oil will be greatly improved both in smell and colour. Where a greater purity is required, the quantity of pearl ashes must be increased, and the time before the addition of the salt and water prolonged.

If the same operation is repeated several times, diminishing each time the quantity of ingredients one half, the oil may be brought to a very light colour, and rendered equally sweet in smell with the common spermacetti oil. By this process the cod-oil may be made to burn, and when it is so putrid as not to be fit for any use, either alone or mixed, it may be so corrected by the first part of the process, as to be equal to that commonly sold: but where this process is practised in the case of such putrid oil, use half an ounce of lime.

### PROCESS THE THIRD.

To purify fish oil with the assistance of heat, where the greatest purity is required, and particularly for the woolen manufacture.

Take a gallon of crude stinking oil, and mix it with a quarter of an ounce of powdered chalk, a quarter of an ounce of lime, slacked in the air, and half a pint of water; stir them together; and when they have stood some hours, add a pint of water and two ounces of pearl-ashes, and place them over a fire that will just keep them simmering, till the oil appears of a light amber colour, and has lost all smell except a hot greasy, soap-like scent. Then superadd half a pint of water, in which an ounce of salt has been dissolved; and having boiled them half an hour, pour them into a proper vessel, and let them stand till the seperation of the oil, water and lime be made, as in the preceding process. When this operation is performed to prepare oil for the woolen manufacture the salt may be omitted; but the separation of the lime from the oil will be slower, and a longer boiling will be necessary.

If the oil be required to be yet more pure, treat it, after it is separated from the water, &c. according to the second process with an ounce of chalk, a quarter of an ounce of pearl ashes and half an ounce of chalk.

In his observations on these different processes the author apprises us that process the first will render oils more fit for burning, which are in that point faulty, and is of use merely when a moderate improvement is required. That when the oil is taken from the dregs and brine, the dregs should likewise be taken off and put into another vessel of a deep form, fresh water added, and stirred with them, and nearly the whole of the remaining part of the oil will separate from the foulness; or the dregs may be put to any future quantity of oil that is to be edulcorated by this method, which will answer the same purpose.

Process the third he says is best for train oil, called vicious whale oil; and the more putrid and foul, the greater the proportional improvement, especially if there be no mixture of the other kinds of fish-oils, particularly the seal, which do not admit of being edulcorated by heat. Oil thus purified will burn without leaving any remains of foulness, and being more fluid than before will go further when used in woolen manufacture, and be more easily severed from the wool.

If a more thick oil be wanted a certain proportion of tallow or fat may be added, and kitchen stuff, which will dissolve in oil moderately heated. It may be necessary to vary the proportions of the ingredients, if the oil be very vicious, as the quantity above stated is the least that will be suitable. If in six or eight hours simmering the oil does not appear to be improving, a fourth or third part of the original quantity may be added. Fresh additions of water must be made as the quantity is lessened by evaporation. If it be inconvenient to give the whole time of boiling at once, the fire may go out and be rekindled at any distance of time, and a small proportion of pearl ashes dissolved in water being added and stirred in between the time of boiling will facilitate the operation.

### PROCESS THE FOURTH.

Which may be practised instead of process the first, as it will purify fish-oil to a considerable degree, and for process the third when the whole is performed.

Take a gallon of crude fetid oil, and put to it a pint of water, poured from two ounces of lime slacked in the air; let them stand together, and stir them several times for the first twenty-four hours; then let them stand a day, and the lime water will sink below the oil, which must be carefully separated from them. This oil if not sufficiently purified to be treated as in process the third, diminishing the quantity of pearl ashes to one ounce and omitting the lime and chalk.

The dregs remaining after the sundry processes above mentioned, will form an excellent manure, as has been since noticed in Dr. Hunter's Georgical Essays.

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## ACCOUNT OF AN APPARATUS

FOR PURIFYING INFECTED AIR (WHICH ACTS FOR SOME MONTHS WITH A SINGLE CHARGE.) BY M. GUYTON DE MORVEAU.—ANN. DE CHIM.

THIS apparatus is formed of a vessel of very thick glass, which holds about three half-pints; the edge of the vessel, which is very thick, has a strong glass plate ground on it so as to fit it perfectly close. This vessel is fixed in a small frame, resembling a press, which has a screw in its upper part, which serves to elevate or depress the plate of glass, so as to open or shut the apparatus at pleasure.

To produce the disinfecting gas, the vessel is taken from the press, and one ounce three drachms of black oxyd of manganese, in powder, after being sifted, put into it, together with a decilitre (the fifth of a pint) of pure nitrick acid, of the specifick gravity of 39 degrees of Baume's areometer, and the same quantity of marine acid, of $17\frac{1}{2}$ degrees: the vessel is then replaced in the press, and the glass plate screwed down tight, after carefully wiping all dirt from the edge of the vessel; two thirds of the vessel must be left empty for the gas.

When it is required to purify the air of any place; it is only necessary to turn the screw the reverse way a single round and leave the vessel open a minute or two according to the size of the place, till the odour of the gas is perceptible in every part of it; after which the whole should be closed tight again.

This apparatus, with a single charge of the above materials may be used every day for six months, without renewal; and when its effect ceases, the vessel is to be emptied, rinsed clean, and filled again as before directed.

In opening the vessel, care should be taken to keep it in an upright posture, to prevent spilling the materials enclosed: and to hold one's head a little from it, to avoid breathing the gas, which, though not dangerous, is a little disagreeable.

This apparatus is very useful to purify the air in hospitals, prisons, sleeping-rooms, and work-shops, and, in fine, in every place where the air becomes vitiated, either from crowded meetings, or other causes. It is now in use in the different hospitals of Paris, in those of the departments and of the marine.

This apparatus is made for sale, by M. Dumotiez, instrument-maker, Paris. He also prepares a smaller portable sort, contrived likewise by M. Morveau, which consists of a strong bottle (closed, as described in the former, by a strong plate of glass and a screw) the whole is enclosed in a case of box wood, which serves to keep the plate of glass in its place. The charge for this is four grammes (about one drachm) of manganese, and about a centilitre (the 50th part of a pint) of nitrick acid, and the same quantity of marine acid: from these proportions, it seems the bottle should hold about half a pint. When the mixture becomes a little old, it should be shaken in the bottle, before unscrewing the stopper.

M. Dumotiez prepares bottles of a still smaller size, in the same manner, which he sells for three francs.

The top of the case should have an opening to let the gas pass, besides being contrived to take off occasionally.

## OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

This is a very convenient apparatus, worthy the attention of all medical gentlemen. Besides the situations where it is of use, mentioned above, it would also be extremely serviceable in ships, and is so very handy, and may be afforded so cheap, that it is probable no captain would go on any distant voyage without one, if its utility were explained to him, in preventing infections of all sorts, not excepting that of the yellow fever.

If the glass plate should be broken at sea, or elsewhere, where it cannot be easily renewed, a piece of caoutchouc, fastened under a cover of wood, would make a good substitute for it; and it might be advisable to have a cover so prepared with every apparatus to use in case of accidents.

The screw, and every other part of the apparatus, should be of wood; as any thing of metal near it would be easily corroded by the gas.

Conceiving these fumigating bottles to be of great publick utility; and that of course it would be very serviceable to have them as easily procured in this city as in Paris; means have been taken to induce Mr. Lloyd, No. 178, Strand, to have them made for publick use, fully equal to those described in every respect.

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## ON THE SUBSTANCES

### USED FOR THE CLARIFICATION OF WINES AND BEER, AND THE MEANS OF INCREASING THE SUPPLY OF FISH GLUE.—BY M. PARMENTIER. ANN. DE CHIM.

M. PARMENTIER thinks that the whites of eggs afford the best substitute for clarification, and that the action of fish glue, for the same use is chiefly caused by the albumen contained in it. On account, however, of the great difficulty of procuring any number, without some musty or otherwise ill-tasted being among them, and the unconquerable bad flavour which this gives to wine, he much recommends the general use of fish glue for this purpose in preference.

He mentions that the air bladders, intestines and skins of various other fishes besides the sturgeon, will produce good fish glue.

The Laplanders procure it from the perch; and all the genus of fishes known to naturalists by the appellation of cartilaginous, such as rays, sea dogs, &c. produce a glue very tenacious and in great abundance.

All fishes likewise, which are little covered with scales, which live in still fresh water, or in bogs, little agitated by wind, or which lie in the mud, are very proper to furnish, from all their parts, a gelatine more or less pure, according to the care taken in its manufacture.

The air-bladders of the cod-fish also produce good glue. In the north of Europe they make a great deal in this manner: they cut out the vesicles, with their ligaments, divide them in two, and remove the first skin, with a notched knife, then lay them in lime water, and afterwards wash them in pure water, and dry them. This was attempted at Newfoundland, but was laid aside because they could not spare hands from fishing; and they now salt the vesicles for food, and they are considered as very wholesome and nutritive. Many other fishes of this species, as well as the cod, furnish materials for glue.

The cuttle fish, the sea-blubber, and similar boneless fishes, with most animals of the mollusca genus furnish the very best gelatine that can be procured, if care be taken to prepare it in a proper manner. It is of similar substances that a species of swallow forms those nests, which are in high estimation in China for making restorative soups.

M. Parmentier thinks that on account of the less specifick gravity of fish glue, it is not so nourishing as the gelatine extracted from land animals, and also that it is not so tenacious as glue formed from the skin and bones of quadrupeds; both of which notions are contrary to general opinion.

M. Parmentier mentions, that in some breweries they boil all the cows and calves feet they can procure, to form gelatinous matter to clarify their beer, and that when these were scarce, they have been known to boil down an entire calf, in their coppers, after removing the fat; and that cartilaginous fishes are also used for the same purpose. Serum of blood has likewise been used by them but they would seldom confess this, knowing the repugnance which most have for such matters.

M. Parmentier examined the finings or clarifying mixture used by several brewers, by chymical tests; from which it appeared that their basis was animal gelatine, precisely of the nature of Flanders glue, and had not the least resemblance to fish glue.

He also mentions that very fine sand, well washed, mixed with the liquor, is a good clarifier, and has the advantage of cheapness.

Charcoal dust likewise, well washed, is found useful in fining liquors.

He recounts another matter, not so advisable for liquor, which is metal in grains, particularly lead, but which is best for clarifying oils, and rendering them colourless. It is not merely by its weight that lead acts on oil, but by a chymical process; for small shot put into a vessel of oil soon become oxydated at its surface and this oxyd attracts the colouring matter of the liquor, which he supposes assists the union of the mucus to the oil; for in proportion as the colouring matter is attracted by the oxyd, the mucus separates and falls to the bottom, by which the oil becomes more fluid, almost colourless, does not congeal in cold weather, burns with brilliancy, and yields little smoke.

M. Parmentier, in conjunction with M. Pelletier, also proved that, in many cases, the clear jelly, procured by boiling raspings of bone in a small quantity of water, might be advantageously substituted for fish glue.

The editors of the Retrospect of Arts, observe on this subject, as follows:

M. Parmentier passes over the effect of charcoal dust, as a clarifier, more hastily than it seems to deserve. From its known attraction for mucilaginous matter, it promises to have great effect in clearing liquor, and perhaps it might be used to advantage after gelatinous finings, to separate them more completely from the liquor.

As a clarifier in the same class as fine sand, very pure pipe clay deserves notice. It separates, on resting, entirely from the liquor with which it is mixed, and draws down with it more extraneous matter than sand can; which qualities make it worthy of sufficient trial.

The recommendation of M. Parmentier to his countrymen, to procure fish glue from the animals found on their own coasts may with great propriety be extended to this country. Animals of soft substance (the more proper for this manufacture as they are never used for food) are to be found on our coasts, in many places in abundance. Hundreds of the fish, often called sea blubber are frequently seen at no great distance from the coast of Milford; and no doubt they, and others of the same kind, and of the sorts before mentioned, as proper for making fish glue, might be procured in many places in sufficient quantity to pay well for the trouble of boiling them down into glue.

## OBSERVATION BY T. G. F.

I think that my countrymen may derive many useful hints from this article. We have many species of fishes and other animals both on our coasts and in our inland waters, of little or no value for food; which might probably be converted into glue. The catfish, the lamprey, land turtle, and perhaps the frog, &c. I recollect to have seen it asserted in an English Philosophical Journal, that a frog, having leaped by accident into a concentrated solution of potash freed from carbonick acid, which was converted in a short time to a flesh coloured gelatinous mass, which by boiling water was dissolved to jelly. The following article will furnish further information on this subject.

### GLUE FROM VARIOUS MATERIALS, EXAMINED. ANN. DES ARTS, &c.*

M. Cadet has examined the nature of glue, prepared from the gelatine of beef, veal, mutton, fowl, fish, and from that of the horse; also mixed glue, prepared from beef gelatine, the scrapings of hides, English glue, beef and veal mixed; and that from ox-feet and sinews. The specifick gravity of each was as follows in the table; and 5760 grains of each, exposed twenty-four hours in a cool cellar after being dried in a stove, absorbed moisture in the proportions therein set down; half an ounce of each glue, dissolved in water, was also saturated with tannin, and the number of grains of precipitate were weighed, and found to be as noted in the table; in which, also, is marked the tenacity of each kind of glue, by the number of pounds and ounces which it took to detach two pieces of wood, of four square inches surface, glued together with each kind of glue, and placed in a stove twenty-four hours before trial.

* This article is from the "Retrospect of Discoveries."

| | Specific gravity. | Absorption. | Precipitate. | Tenacity. | | Colour. |
|---|---|---|---|---|---|---|
| | | grs. | grs. | lb. | oz. | |
| Glue of Veal .... | 1352 | 198 | 71 | 110 | 6 | Transparent, like horn. |
| —Beef ....... | 1229 | 159 | 4 | 95 | 6 | Very transparent like barley sugar. |
| —Mutton ..... | 1344 | 171 | 50 | 107 | 6 | Clear, dull redish. |
| —Horse ...... | 1342 | 173 | 40 | 66 | 6 | Almost opaque, of a deep redish brown. |
| —Fish (of commerce) ..... | 1209 | 422 | 56 | 53 | 6 | |
| —Fish (in casks) | 1231 | | | | | Like beef glue but more transparent |
| —Fowl ....... | 1321 | 1298 | 36 | 99 | 6 | Clear, of a dull bistre. |
| —Beef & hide scrapings ... | 1315 | 253 | — | 91 | 6 | |
| —Beef & veal .. | 1350 | 160 | — | 79 | 6 | |
| —Ox heels & sinews ..... | 1351 | 124 | — | — | — | |
| English glue ..... | 1347 | 144 | 60 | 121 | 14 | |

Each of the above columns formed a separate table in the original; but it was thought it would be more satisfactory to give the whole in one view, as here.

The precipitates were each of different colour and form: some were pulverulent, others filamentose, and others formed a magma.

As the tenacity depends, in some degree, on the wood subjected to the action of the glue, to the liquidity of the glue, its temperature, and the manner of application, the above comparison can only be considered as an approximation to an exact statement.

The solutions of English glue, of mutton, and of veal, had more viscosity than those of the others, particularly of the first in the following list, in which each is placed according to its degree of solubility in portions of boiling water:

| | |
|---|---|
| Beef glue | English glue |
| Beef and veal mixed | Beef and hide scrapings |
| Horse glue | Mutton |
| Ox heel and sinews | Veal |

Of all the above, the English glue is the strongest; that of veal the next, and its gelatine the best for medicinal use. Beef glue is the least absorbent of moisture, and horse glue the weakest of all: mutton glue is next to that of veal in its qualities.

Glue not only varies according to the animals whence it is prepared, but according to the different parts of the same animal: that made, for example, from the heels of beef, varies much from that made from other parts, as may be seen in the table.

M. Cadet attributes the superiority of the English glue to the great care taken by the makers to put matters of the same nature in each boiling, and which are soluble in the same temperature, and furnish gelatine equally.

The goodness of the glue depends on the freshness of the materials, the choice of them and their mixture; the washing of them, and the method of boiling, require, also much attention; and, perhaps the action of the lime on the first materials, may greatly influence the quality.

The construction of the furnaces is, also very important in the manufacture of glue. Mr. C. visited several works, and saw none in which they were properly formed.

### OBSERVATIONS, BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

M. Cadet very properly conjectures, that lime is an important article in the preparation of glue. In some small experiments made, of preparing glue from different substances, all that had not been limed, absorbed the moisture of the air so much, that they speedily became flexible; from this it is probable, that the liming adds to the strength of the glue; for it is evident, that any which absorbs moisture, must speedily lose its connecting power. There is reason to think some glue-boilers use alum for the same purpose; as, in some account of the process lately published, with a different view than explaining the manufacture, it is directed to use a pound of alum for every hundred weight of the materials.

Sea salt, even in small quantities, increases much the attraction of glue for damp: some materials, which cannot be got to harden permanently, it is suspected, owe this defect to the salt contained in them: indeed all animal substances contain some portions of it; perhaps the alum may tend to decompose the sea-salt, and form in its place sulphate of soda, which is the most drying of all salts.

Glue is an important manufacture, both on account of its extensive use in various arts, and the quantity exported.

The materials for it are becoming every day more scarce and dear; which makes it an object of consequence, to seek for others besides those in common use: in the paper on the clarification of Liquors, some of those will be found mentioned, which might be applied to the general manufacture, as well as to the particular article of fish-glue. A great supply of excellent materials might be obtained from the whale fishery, and that of the other different sea animals which yield oil. A great part of the lower extremity of all those fishes consists of sinews which would make good glue, together with their fins and tails. Mr. Raines, of Hull, obtained a patent in November, 1804, for making glue from the tail, fins, and grisly parts of the whale. There is, however, a part of the whale, not mentioned in Mr. Raines's specification, not of a grisly nature, which is very abundant, and which, from analogy, seems very likely to be a good article for this purpose.

Dr. Hunter, in his anatomy of the whale, mentions that the cutis and cuticle have in this animal very little connexion, which in all land animals form but one substance. The cuticle of the whale is very thin; and this, from its little adherence to the cutis, seamen esteem only the skin of the animal: but, under this lies the cutis, nearly an inch thick acording to Dr. Hunter; and, it is this part that is here recommended. It is the cutis alone of the skin of other animals that is soluble, and very good glue may be made from this part of most animals. It is therefore probable, that the same part of the whale might yield glue; that it at least deserves a trial; and as glue is much dearer than fish oil by the pound, those concerned in the whale fishery might find their account in bringing home materials for glue as well as oil. The preservation of the parts of the whale fit for making glue might be effected by using lime for them, in the same manner as salt is used to preserve flesh for food; and it is very likely nothing more would be necessary but to cask them up with sufficient lime to fill every interval between each stratum, and absorb all moisture: when circumstances would permit, those articles should be dried as much as possible before being casked. The expense or trouble of taking out a few casks of lime for this purpose would be but trifling; and it is more than probable that whoever will make the trial once, will always bring out lime in future to prepare those articles.

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# FACTS RELATIVE TO MILDEW

## WITH REMARKS, &c.—YOUNG'S ANNALS.

THE mass of intelligence which Mr. A. Young has collected from various parts of the kingdom relative to the nature and causes of the mildew, which latterly has been particularly destructive, confers a considerable benefit on this country, and does honour to his patriotick exertions.

From comparing the various accounts published from the above source, the following circumstances appear.

The cause of mildew is now accurately proved to arise from a species of very minute fungus, which inserting its roots into the pith of the plant, absorbs the nourishment intended for the grain, which grain afterwards consists of little else but husk.

The engraving of this fungus, from the drawings of Mr. Bauer, botanical painter to his majesty, as it appeared highly magnified, show that the seed-vessel of it is somewhat of the nature of the puff-ball, and as its seed is minute in proportion to the size of the plant, the vast number each produces may be judged from what we see in the other fungus; Sir Joseph Banks is of opinion that from the first insertion of the plant to its producing seed is not more than a week in hot weather, and that every pore in the straw where they take root, will produce from twenty to forty plants; and as this seed is not heavier than air, the quick propagation and prodigious extent to which it spreads is hence easily accounted for. The least breeze conveys the seed in every direction, and whenever it finds a proper receptacle, then it directly takes root and propagates its destructive offspring.

There are in all plants a vast number of minute pores intended to absorb moisture from the air, possessing a peculiar mechanism which causes them to *open in damp weather*, and close in dry; these pores, situated in longitudinal furrows in the straw or reed of the grain-bearing plants, are, in the opinion of the hon. baronet before mentioned, the favourite niches of the mildew; he also thinks that of all plants it prefers the barberry bush, where it thrives with peculiar vigour, and therefore every barberry may be considered as a strong attractor first, and afterwards a powerful propagator of this noxious fungus.

Every species of fungus thrives best in damp and shade, and some will not grow without them: this shows the reason why in general open situations were less subject to the mildew, and a crop not too thick, but which admitted a free circulation of air among its reeds, and also shows why drilled crops from the last mentioned circumstance frequently escaped, and why damp soils, damp weather, shade of all kinds, and every thing that produced or retained moisture, favoured the growth of mildew.

The fungus also thrives in the site of old dunghills and wherever putrefaction has existed. This shows why dunged crops were in general subject to it, while those which were on a fallow, or followed a crop, which had reduced the manure to mould previously, were much less affected; it is not improbable in this case but that the litter might actually contain the mildew in a state of strong vegetation, and that the farmer might thus in reality plant the mildew at the time he prepared the ground for his wheat.

When the stems of wheat or other grain were well covered with the leaf, provided the circulation of the air was free, it in general kept off the mildew; weakly plants were subject to it from wanting this defence, and barley mostly escaped; and bearded wheat, and other kinds in which the reed is not so much exposed, were not damaged to so great a degree. Weakly plants seemed subject to it from other causes likewise, perhaps from the stagnation of their juices favouring its growth.

It is very probable that the pores (before mentioned) of plants serve the double purpose of absorption and perspiration, and (as every plant is a kind of pneumato-hydraulick engine, in which heat causes expansion of the contained air and fluids, and consequent transudation and evaporation, and cold occasions contraction and by it absorption through the pores) this shows why the mildew was observed to spread most rapidly when the weather was such as produced these exciting causes most strongly and in quick succession; hence a cold night or frost after a hot day, very great damp after much heat, and particularly of that kind of damp which admitting evaporation of itself from the surface of the plant, caused a greater chill to it, while it made the pores open at the same time, were observed to favour the mildew; for a stronger absorption thus taking place, more of the seeds of the fungus would enter the pores of the plants along with the current of moisture, and perhaps also of air, then entering these passages on their way to the internal vessels.

Hot weather is necessary to the growth of mildew; for this reason the crops which admitted of more early reaping, and were thereby less time exposed, and which also escaped the great change of temparature between the days and nights at the end of autumn, were also less subject to the mildew.

Other countries are as much subject to the mildew as this. Italy and Sicily suffer very much from it, and even New South Wales has its crops injured by the same cause.

The small grain (caused by the mildew) though unfit for the mill, is, however, not injured in its vegetating power; and, according to the same respectable authority before mentioned, is as fit for seed as the plumpest and heaviest grain; because one tenth of the contents of a grain of good wheat is sufficient for the support of the nascent plant; the greater proportion of farina at present existing in those grains, being the effect of cultivation more than the nature of the plant; as, in like manner, the apple, pear, and many other fruits, exceed in size those in the wild state, by the same means.

Of this small grain a less quantity per acre may also be used for seed, inasmuch as every bushel of it will contain a vastly greater number of seeds; and Sir Joseph thinks that three bushels of the small grain will fully equal four of the large.

It seems to be a pretty general opinion, that mildewed crops should be reaped as soon as the grain is filled with its milk, for as the supply of nutriment is cut off by the mildew, evaporation will carry off more moisture than the plant supplies when standing, and thus cause the grain to shrivel, but when cut, the grain being more shaded, dries with less loss of weight.

| *Circumstances favouring the propagation and increase of Mildew.* | *Preventives of Mildew.* |
| --- | --- |
| Damp and moisture of all kinds, particularly in a stagnate state.<br>Fog, mist, and evaporation from the soil. | Sowing on well drained and dry soils.<br>Keeping hedges and other fences low, and enlarging enclosures.<br>Drilling and dibbling with wide intervals.<br>Perhaps furrows and drills running east and west, would cause a greater circulation of air, from winds in those quarters being most prevalent |
| Shade. Thickness of crop. Plants too close to admit free air.<br>Warmth.<br>Sudden and great changes of temperature of air from hot to cold.<br>Calm and still air.<br>Stable manure and litter in an undecomposed state. | By choosing kinds of grain which ripen early; early sowing, or by other means to manage so as to reap early.<br>To use no stable manure for wheat but what has lain in heaps above two years; or never to sow it but after a fallow or preparatory crop. |
| The vicinity of the barberry bush. | Removal of the barberry.<br>Good preparation of the ground, and perhaps paring and burning at certain intervals in the course of crops, to destroy insects, worms, &c. vegetables, stems, or stubble, infected with mildew. |
| Weakly state of vegetation from whatever cause. | Preferring kinds which have the stems best sheltered with leaves, and heads bearded. |

# METHOD

## OF RELIEVING CATTLE OR SHEEP, WHEN THEY ARE HOVEN, OR SWOLLEN.

DESCRIPTION OF A SIMPLE BUT EFFECTUAL METHOD OF RELIEVING CATTLE AND SHEEP, WHEN, FROM EATING TOO VORACIOUSLY OF CLOVER, OR ANY OTHER SUCCULENT FOOD, THEY BECOME SWOLLEN, OR IN THE LANGUAGE OF THE FARMER, *HOVEN*. BY MR. RICHARD EAGER, OF GROFFHAM FARM, NEAR GUILDFORD, ENGLAND.

FROM THE TRANSACTIONS OF THE SOCIETY OF ARTS, &C.

A BOUNTY of fifty guineas was voted to Mr. Eager for the communication of this method.

As young clover, rape, and turnips, are of a succulent nature, cattle are induced to eat more than they otherwise would do, the quantity of fixed air, which that sort of food produces, more than common grass, makes the cattle more liable to be blown with that than with any other food. The extra quantity of air taken down occasions the necessity of more wind being discharged from the paunch of the beast upwards; this forces the broad leaves before the passage at the entrance of the paunch, which stops the wind from going upwards in its regular course; the paunch immediately begins to swell; the heat of the body rarifies the air, in so rapid a manner that it stops the circulation of the blood; and the beast, whether bullock or sheep dies in half an hour.

Previous to the discovery of the method herein described, the cure used to be attempted by stabbing the animal in the paunch; a method of proceeding always dangerous, and very frequently fatal.

A. A. plate II, fig. 1, is the knob of wood, and part of the cane to which it is fixed, of a proper size for oxen: the length of the cane to be at least six feet.

B. B. fig. 2, the knob of wood, and part of the cane for sheep: the length of the cane to be about three feet.

### DIRECTIONS FOR USING MR. EAGER'S INSTRUMENT FOR CATTLE.

Let one person take hold of the beast by the nostril and one horn; let another hold his tongue fast in one hand, putting the cane down his throat with the other. Be careful not to let the animal get the knob of the cane between his grinders: observe also to put the cane far enough down; the whole length will not be of injury. You will find the obstacle at the entrance of the paunch; push the cane hard, and when you perceive a smell to come from the paunch, and the animal's body to shrink, the cure is performed, and nature will act for itself.

Annexed to the foregoing account is a letter from lord Egremont, in which his lordship says that he is convinced Mr. Eager is right in thinking that the disorder of cattle, herein described is occasioned solely by the vent upwards for the wind being obstructed; and that Mr. Eager's instrument removes the obstruction; which removal he believes to be an easy and infallible cure.

There was likewise a certificate by Mr. Charles Ellis, of Noar Farm, in the parish of Bromley, stating a cure performed on an ox so violently hoven or swollen, that he must have died in a short time, but Mr. Eager applied his instrument, and effectually cured him in two minutes. The animal returned to his food, and ate as heartily as he had done before.

Mr. Eager mentions another instrument, which he says he has found useful for removing turnips or potatoes, when a bullock, fed with either of these roots, gets them stuck fast in his throat. He adds that he thereby saved two of his own, but does not describe, nor give a drawing of the instrument.

## OBSERVATION BY T. G. F.

Many valuable cattle are lost in America by their having eaten too voraciously of green maize or Indian corn. Probably the simple remedy above described might be efficacious in cases of that kind; although it is generally thought that the disease occasioned by the *swelling* of the food merely, and not by the obstruction of the passage upwards. It is at least worth the experiment.

# ON THE DANGER

## OF USING VESSELS OF LEAD, COPPER, OR BRASS, IN DAIRIES. BY MR. THOMAS HAYES, SURGEON, OF HAMPSTEAD.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY FOR THE ENCOURAGEMENT OF AGRICULTURE, &c.

MANY eminent physicians have asserted, that butter is very unwholesome; while others equally eminent, have considered it not only innocent, but as a good assistant to digestion; and each have been said to ground their opinions upon experience. Perhaps both may be right; and butter may be innocent or mischievous, according as it contains many or few adventitious materials, collected from vessels, &c. used in the process of making it.

I am led to these conjectures by observing, that in almost all the great dairies, the milk is suffered to stand in lead, brass, or copper vessels, to throw up the cream. The closeness of the texture of these metals, and their coldness and solidity, contribute to separate a greater quantity of cream from the milk than would be done by wooden trundles, or earthen pans, both of which are also sometimes made use of.

As I wish to establish the possibility of the fact, that milk may corrode or dissolve particles of the vessels abovementioned, and thereupon be liable to communicate pernicious qualities to the butter, I beg leave to submit the reasons from which I draw this conclusion.

Whoever has been much in great dairies must have observed a peculiarly sour, frowsy smell in them, although they have been ever so well attended to in point of cleanliness, &c. In some, where the managers are not very cleanly, this smell is extremely disagreeable, owing mostly to the corrupted milk. In some it arises from the utensils being scalded in the dairy, and in others from a bad construction of the building itself, the want of a sufficient circulation of air, water, &c. but in all, a great deal of the lighter and more volatile parts of the milk fly off from the surface of the pans, and furnish a great quantity of acid effluvia to the surrounding air and cieling; which is again deposited on every thing beneath it, and of course often on the vessels, after they have been put by clean, at the times of their being out of use.

This may be observed to give a dull sort of an appearance to brass and copper, as if you had breathed upon them; for if you rub your fingers lightly over the vessels, you will have both the taste and smell of the metal.

It also happens sometimes, that after the vessels were washed, they are not carefully rinsed, nor perfectly dried by the fire; so that some of the milk, &c. is left on their surface, which dissolves the metals, either by its animal, oily, or acescent qualities.

This is not the only way, nor the worst, by which the butter may become impregnated with mischief. The greater the quantity of cream thrown up from the milk, the larger the profits accruing to the dairy-man; therefore he keeps it as long as he can, and it is frequently kept till it is very sour, and capable of acting upon them; if they are of lead, a calx or sugar of lead is produced; if brass or copper, verdigris.

It is true that the quantity cannot be very great; this however will depend upon the degree of sourness, and length of time which the milk stands; but, independent of the acid, the animal oil in the cream will dissolve brass and copper.

That an acid floats in the atmosphere of a dairy, may be proved, by placing therein a basin of syrup of violets, for a little time, which will be found to turn red.

If then I am right in my conjectures, as I think I am, from the innumerable experiments and observations which I have made to satisfy myself of the fact, and which it would be trifling to relate here, may not the reputation of wholesomeness, or unwholesomeness of butter depend upon or be owing to some of the above causes? And may not many a casual, nay, obstinate complaint, which physicians have laboured in vain to account for, have originated from this source? Butter is found, very frequently, to occasion much disorder to very weakly, delicate and irritable stomachs, yet these stomachs will bear olive-oil: this cannot easily be accounted for, but from metalick impregnation.

I will not contend, that all the ill effects attributed to butter are caused by the mineral particles, which it gains by the means above stated. I only insist that it is possible, and indeed very probable; and that, when butter is free from these particles, it is not so unwholesome as asserted; though, when it does not contain them, it is found to disorder very tender persons.

To enlarge upon the subject, or attempt to explain the many ways by which a very small quantity of the above metals may prove injurious to the human frame, in some particular constitutions, would be only to repeat what has already been said by older writers.* Some will perhaps say that my ideas are very far fetched, and others that my opinions are ill-founded; but I trust, whoever has read the industrious researches of Sir George Baker, on the effects of lead, and the melancholy case of a young lady, who died from eating pickled samphire, very slightly impregnated with copper, and which others ate without being diseased, as related by Dr. Percival, will receive my opinions with less objection. If I have erred, I have done it in honourable company.

I shall be very glad if the foregoing observations have sufficient influence on the dairy-men, to induce them to change their utensils. Very commodious vessels may be made of cast iron, equally well fitted for the purposes of the dairy, which will not be expensive, and will be more innocent and cleanly.

To this article we shall subjoin an abridgment of a tract

ON MAKING BUTTER AND CHEESE, BY MR. JOSIAH HAZARD, OF STONY LITTLETON, SOMERSETSHIRE, ENGLAND.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY, FOR THE ENCOURAGEMENT OF AGRICULTURE.

The writer states that the Epping butter is known to be superiour to any other kind; that he had occupied a large farm in the neighbourhood of Epping, and had likewise been a resident in Somerset; and in both counties his butter would procure him, in general, a halfpenny a pound more than the general market-price.

The dairy house he would have kept in the neatest order and it should never front the south, south-east, or south-west: lattices are to be preferred to windows, as they admit a more free circulation of air than glazed lights. To prevent their admitting too much cold air

* See Sir George Baker's papers on the effects of lead, in the Medical transactions; Dr. Percival's paper on the same; and Dr. Falconer on copper vessels.

in winter, and the sun in summer he would have a frame of the size of, or somewhat larger than the lattice, so as to slide backward and forward at pleasure, and pack-thread strained across this frame, with oiled cap-paper pasted thereon, which will admit light and keep out the wind and intense rays of the sun.

In summer it is hardly possible to keep the dairy house too cool, and he would therefore have it situated near a good spring or current of water. It should be neatly paved either with red brick or smooth hard stones, and laid with a proper descent, so that no water may lodge. This pavement should be well washed in the summer every day, and all the utensils, belonging to the dairy should be kept perfectly clean; nor should churns or other utensils ever be scalded in the dairy as the steam which would rise from the hot water would injure the milk. Cheese should not be kept therein, nor runnet for making cheese, nor should a cheese press be fixed in a dairy, as the whey and curd will diffuse their acidity through the room.

The proper receptacles for milk are earthen pans, or wooden vats or trundles, but none of these should be lined with lead, as the poisonous nature of that metal will affect the milk. If, however, people will obstinately persist in their use, they may, by scalding them and scrubbing them thoroughly with salt and water, till no sour smell can be in the least perceived, in a degree, lessen their bad effects.

The greater the quantity of butter, which is made from a few cows the greater the profit of the farmer; therefore none should be kept, which are not esteemed "good milkers." A bad cow will cost as much to feed, and produce not more than half so much butter and cheese. Farmers ought to be careful how they trust negligent servants with the milking of their cows, and frequently attend themselves to see that their cows are milked clean; for if any milk be left in the udder, the cow will daily give less, and the next season will not afford sufficient to pay for the expense of keeping.

If the cow's teats are scratched or wounded, the milk will be foul and tainted and should by no means be mixed with that which is pure but be given to the swine. When the milk is conveyed to the dairy house it should be suffered, in warm weather, to remain in the pail till nearly cool before it is strained, but in frosty weather it should be strained immediately, and a small quantity of boiling water may be mixed with it, which will cause it to produce cream in great abundance, and the more so, if the pans or vats have a large surface.

In hot weather the cream should be skimmed from the milk, at or before sun rise, before the dairy becomes warm, nor should the milk in hot weather stand in its receptacles longer than twenty-four hours, nor be skimmed in the evening till after sun-set. In winter milk may remain unskimmed thirty-six or forty-eight hours. The cream should be deposited in a deep pan, kept during summer in a cool place where a free air is admitted. Unless churning is performed every other day, the cream should be shifted daily into clean pans, but churning should always be performed at least twice a week, in hot weather; and this should be performed in the morning before sun-rise, taking care to fix the churn where there is a free draught of air. If a pump churn is used it may be plunged a foot deep in cold water, and remain in that situation, during the whole time of churning, which will much harden the butter. A strong rancid flavour will be given to the butter, if we churn so near the fire as to heat the wood in the winter season.*

After the butter is churned, it should be immediately washed in many different waters, till it is perfectly cleansed from the milk; and should be worked by two pieces of wood, for a warm hand will soften it, and make it appear greasy.

Butter will require and endure more working in winter than in summer.

Those who use a pump churn must keep a regular stroke: nor should they permit any person to assist them, except they keep nearly the same stroke; for if they churn more slowly, the butter will in the winter *go back* as it is called; and if the stroke be more quick and violent in the summer, it will cause a fermentation, by which means the butter will acquire a very disagreeable flavour.

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* In the volume from which this is taken it is said (in a letter signed Rusticus) that the operation of churning may be very much shortened, by mixing a little distilled vinegar with the cream in the churn. The butter being afterwards well washed in two or three changes of water, the whole of the acid will be carried off; or if any remain it will not be perceived by the taste. A table spoonful or two of the vinegar, to a gallon of cream.

When many cows are kept, a barrel churn is to be preferred; but if it be not kept very clean, the bad effects will be perceived in the butter; and the situation of the churn must be shifted as the seasons alter, so as to fix it in a warm place in winter, and in a cool and airy situation in summer.

In many parts of this kingdom they colour their butter in winter; but this adds nothing to its goodness; it rarely happens that the farmers in or near Epping use any colour, and when they do it is very innocent. They procure some sound carrots, whose juice they press through a sieve, and mix with the cream, when it enters the churn, which makes it appear like May butter; nor do they at any time use much salt, though a little is absolutely necessary.

As they make in that county but very little cheese, so of course very little whey-butter is made. This will not keep good more than two days, and the whey will turn to better account to fatten pigs. Nothing feeds them faster, nor will any thing make them more delicately white although good bacon cannot be made from pigs thus fatted.

The writer subjoins the *West-country* method of making butter, which he describes as follows:

In the first place, they deposit their milk in earthen pans in their dairy-house; when they have stood twelve hours in the summer, and double that space in the winter, they remove them to stoves made for that purpose, which stoves are filled with hot embers: on these they remain till bubbles arise, and the cream changes its colour: it is then deemed heated enough; and this they call scalded cream. It is afterwards removed steadily to the dairy, where it remains twelve hours more, and is then skimmed from the milk and put into a tub or churn. Some scald it over the fire, but then smoke is apt to affect it; and in either case if the pans touch the fire they will crack or fly, and the milk and cream will be wasted.

The land whereon cows feed very often affects the butter. If wild garlick, charlock, or may-weed be found in pasture grounds, cows should not feed therein till after they have been mown, when those pernicious plants will appear no more till the following spring; and milch cows must not partake of the hay made therefrom, as that will communicate its bad qualities.

Great part of the Epping butter is made from cows that feed during the summer months in Epping forest, where the leaves and shrubby plants contribute greatly to the flavour of the butter.

The mountains of Wales, the highlands of Scotland, and the moors, commons and heaths of England produce excellent butter, when it is properly managed; and though not equal in quantity far superiour in quality, to that which is produced from the richest meadows.

Turnips and rape affect milk and butter; but brewers grains are sweet and wholesome food, and will make cows give abundance of milk; yet the cream thereon will be thin, except good hay be given at the same time, after every meal of grains. Coleworts and cabbages are also excellent food; and if these and savoys were cultivated for this purpose the farmers would find their account in it.

Cows should never be suffered to drink improper water; stagnated pools, water wherein frogs spawn, common sewers, and ponds that receive the drainings of stables are improper.

## ON MAKING CHEESE.

The *double Gloucester* is made of new, or what is called *covered milk*. An inferiour kind is made from what is called *half covered* milk. It is best where possible to make a large cheese from one meal's milk. If milk which has stood from one milking to another be mixed with that which is fresh from the cow it will be a longer time before it turns, and sometimes will not change till it is heated, by which it frequently gets dust, smoke and soot, which give it a disagreeable flavour.

When the milk is turned, the whey should be carefully strained from the curd, which should be broken small and put a little at a time into the vat, carefully breaking it as it is put in. The vat should be filled an inch or more above the brim, that the curd when the whey is pressed out may not sink below the brim; if it does the cheese will be worth but little. A cheese cloth or strainer should be laid at the bottom of the vat or tub, so large that when it is filled with the curd, the ends of the cloth may turn over the top of it.

When this is done it should be taken to the press and remain two hours, then turned, and a clean cloth put under it, and be turned over as before. It should then be again pressed for six or eight hours, and again turned and rubbed on each side with salt; after which it must be pressed again for twelve or fourteen hours; when if any of the edges project, they should be pared off: the cheese may then be placed on a dry board, and it should be regularly turned every day.

Three or four holes should be bored round the lower part of the vat, that the whey may drain perfectly from the cheese.

The opinion that cheeses will spoil if they are not scraped and washed, where they are found to be mouldy, this writer thinks is erroneous, and that suffering them to mould mellows them, provided they are turned every day; or if the mould is taken off, it ought to be removed by a clean dry flannel, as washing the cheeses is only a mean of making the mould (which is a species of fungus, rooted in the coat) grow again immediately.

This writer condemns the practice of scalding the curd, as it "robs the cheese of its fatness; and can only be done with a view to raise a greater quantity of whey butter, or to bring the cheeses forward for sale, by making them appear older than they are.

A little arnette mixed with the milk, before it is turned will give the cheese a yellow colour, and it is perfectly innocent.

It is not possible to make good cheese with bad runnet, and this writer gives the following receipt.

"The vell, maw, runnet-bag (or by whatever name it is called) should be perfectly sweet; for if it be in the least tainted, the cheese will never be good. When this is perfectly sweet, three pints or two quarts of soft water (clean and sweet) should be mixed with salt, in which should be put sweet brier, rose leaves, and flowers, cinnamon, mace, cloves, and in short almost every sort of spice and aromatick. These should be put into two quarts of water, and boiled gently, till the liquor is reduced to three pints; and care should be taken that the liquor be not smoked. It should be strained clean from the spices, &c. and when found to be not warmer than milk from the cow, it should be poured on the *vell* or *maw;* a lemon may then be sliced into it, when it may remain a day or two; after which it should be strained again, and put into a bottle, where, if well corked it will remain for a year or more. It will smell like a perfume; and a small quantity of it will turn the milk, and give the cheese an agreeable flavour. After this if the vell or runnet bag be salted and dried for a week or two near the fire, it will do for the purpose again, almost as well as before.

This writer attributes the excellence of *Cheshire cheese*, principally to the richness of the land, and the farmer's being able to make cheeses frequently exceeding one hundred pounds weight, without adding "a second meal's milk." They salt the curd, and keep the cheeses in a damp place after they are made, and take care to turn them daily.

Stilton cheese, he informs us is esteemed the Parmesan of England, and except there is some defect in it, is never sold for less than one shilling or fourteen pence per pound.

The Stilton cheeses are made in square vats, and weigh from six to twelve pounds each. They should as soon as made be put into square boxes, which exactly fit them, for without this precaution they frequently bilge and break asunder; they should be daily turned in these boxes, and kept two years before they are properly mellowed for sale. They are sometimes made in a net, like a cabbage net, and appear somewhat like an acorn. These, however, are not so good as those before described, having a thicker coat, and not so rich a flavour. The farmers of Stilton are very remarkable for their cleanliness in their dairies.

The excellence of the Stilton cheeses this writer attributes to the following circumstance. They make a cheese every morning; and to the morning's milk add the cream of that which was milked the night before.

This writer says that it is a wasteful practice to give skimmed milk to pigs; as the whey will afford them as much nutriment, after cheeses have been made from this milk. Such cheeses will always sell at the rate of at least two pence per pound, which will amount to a large sum annually, where they make much butter. The peasants and many of the farmers in the north of England, never eat any better cheeses than these; and though they appear harder, experience has proved them to be much easier of digestion than new milk cheeses.

The writer concludes this valuable communication with the following sentence.

"As I have taken much pains, by actual practice, to find out the defects of others, in making butter and cheese, so through my advice several have attained to perfection in this art; and I shall think myself unworthy your patronage, if all do not excel who will strictly adhere to the methods here laid down."

## REMARKS BY T. G. F.

I think that the preceding papers, on the subject of making butter and cheese, will be found of great practical utility by our farmers. What Mr. Hazard has said relative to the mode of making the best runnet cannot but be of use. The suggestion of making cheese of milk, which has stood for twelve hours, or perhaps in winter for twenty-four hours is well worth attention. The richest cream cheeses are not so wholesome, are not so easily preserved, and to some palates (mine for one) are less agreeable than those which are made from milk which has been once skimmed. Then if the whey after the cheese is made from such skimmed milk, would afford nearly as much nutriment to pigs, as the milk would have done before it had been curdled by the runnet, it must be a wrong and wasteful practice, in general, to feed swine with skimmed milk, instead of making the milk into cheese, and feeding them with the whey. What Mr. Hazard and Mr. Hayes call "trundles" are in some parts of America called *trays*. They are best made, I believe, in America of the rock maple, or *acer saccharinum*, which from its closeness of texture resembles metals as respects the property of separating a great quantity of cream from the milk, and partakes of none of the bad qualities of some metals. With regard to earthen pans I believe that they are frequently *glazed* (as the workmen express it) in America, by an oxyd of lead, which perhaps may be dissolved by the acid, and the animal oil of milk, and be very deleterious. It would likewise be worth the experiment to ascertain if given quantities of milk spread over shallow vessels of a large size, and the milk being but of a *small depth*, might not facilitate the process of procuring cream, sweeter and in greater quantity, than in the common mode. Vessels of tin, I believe, if kept clean and sweet would be found to be very good receptacles for milk in dairies.

# OBSERVATIONS,

BY THE EDITORS OF THE RETROSPECT OF ARTS, ON MR. JOHN SLATER'S PATENT FOR FORMING THE RIGGING AND CABLES OF SHIPS OF METAL CHAINS.—REP. ARTS.

Mr. SLATER obtained this patent in January, 1804; the title is a sufficient description of his object.

The design is no doubt a good one. Some experienced captains of ships have mentioned it as such long before the patent was obtained. It is even better perhaps than the patentee is aware, as in all probability even the first cost would be less for standing rigging of chain than of hemp, from the high price of this latter article. The chief objection is, that the chain is not sufficiently elastick for standing rigging; but it is very possible to obviate this by the addition of properly-constructed springs; and some degree of elasticity may be given to the chain itself, by forming it with spiral links. The danger from lightning might be easily removed by proper conductors, as Mr. Slater observes.

It is the opinion of an experienced captain, that iron chain shrouds should be served with old canvass well greased, and spun-yarn; this would keep them from rusting, and make them more convenient to handle to the men. Mr. Slater does not propose the use of chain for running rigging; and probably it would be best to use hemp lanyards also: but while the design is mentioned as very beneficial, it is proper at the same time to observe, that Mr. Slater's patent cannot extend to the use of chain, either in the place of cables, or for slinging yards; for both which purposes it has been employed beyond the memory of man. Mooring chains are to be found every where; and several ships bring out chain to moor by, to save their hempen cables, which is a very good and economical practice. West-India ships often have their lower yards slung with chain; naval ships have always had chain in addition to the hempen slings, and no doubt other ships also. A West-India captain has slung the three lower yards of his ship with chain, in a new method, by which they were much more movable, and would go about further, than with hempen slings; and used only two fathoms of chain, which cost but eleven shillings. The same captain also used chain hawsers in the West-Indies, several years ago, and speaks much in favour of them. Many more instances might be mentioned in favour of the good effect of the use of chains, and of their having been used before for these purposes; with which perhaps Mr. Slater was not acquainted.

We are not acquainted with any instance of chains having been actually used for standing rigging, though it had been proposed by the captain abovementioned, previous to the year 1804.

## REMARK BY T. G. F.

It did not perhaps occur to Mr. Slater, nor to the editors of the "Retrospect of Discoveries," that metal chains are rendered *brittle* by frost, and of consequence, standing rigging of metal would not be proper for cold climates. Ships, however, designed for trading in warm climates, may perhaps be rigged advantageously according to the above patent.

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## ON THE USE OF STEAM

### AS A VEHICLE FOR CONVEYING HEAT FROM ONE PLACE TO ANOTHER. BY COUNT RUMFORD.

FROM THE JOURNALS OF THE ROYAL INSTITUTION OF GREAT BRITAIN.

MORE than fifty years ago, colonel William Cook, in a paper presented by him to the Royal Society, and published in their Transactions, made a proposal for warming rooms by means of metallick tubes filled with steam, and communicating with a boiler situated out of the room; which proposal was accompanied by an engraving, which showed, in a manner perfectly clear and distinct, how this might be effected. Since that time this scheme has frequently been put in practice with success, both in this country and on the continent*.—Many at-

* Although one should naturally imagine that the notoriety of these facts would have been sufficient to prevent all attempts in our days, to claim a right to this inventiou, yet it is said that a patent for it

tempts have likewise been made, at different periods, to heat liquids by means of steam introduced into them; but most of these have failed: and, indeed, until it was known that the fluids are nonconductors of heat, and, consequently, that heat cannot be made to *descend* in them (which is a recent discovery) these attempts could hardly succeed; for, in order to their being successful, it is absolutely necessary that the tube which conveys the hot steam should open into the *lowest part* of the vessel which contains the liquid to be heated, or on a level with its bottom; but as long as the erroneous opinion obtained, that heat could pass in fluids in all directions, there did not appear to be any reason for placing the opening of the steam tube at the bottom of the vessel, while many where at hand which pointed out other places as being more convenient for it.

But to succeed in heating liquids by steam, it is necessary, not only that the steam should enter the liquid at the bottom of the vessel which contains it, but also that it should enter it *coming from above.* The steam tube should be in a vertical position, and the steam should *descend* through it previous to its entering the vessel, and mixing with the liquid which it is to heat; otherwise this liquid will be in danger of being forced back by this opening into the steam boiler; for the hot steam being suddenly condensed on coming into contact with the cold liquid, a vacuum will necessarily be formed in the end of the tube; into which vacuum the liquid in the vessel, pressed by the whole weight of the incumbent atmosphere, will rush with great force, and with a loud noise; but if this tube be placed in a vertical position, and if it be made to rise to the height of six or seven feet, the liquid which is thus forced into its lower end will not have time to rise to that height before it will be met by steam, and obliged to return back into the vessel. There will be no difficulty in arranging the apparatus in such a manner as effectually to prevent the liquid to be heated from being forced backwards into the steam-boiler; and, when this is done, and some other necessary precautions to prevent accidents are taken, steam may be employed with great advantage for heating liquids; and for keeping them hot, in a

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was taken out only a few years ago. See Mr. Green's specification, published in our first volume, page 21.

variety of cases, in which fire, applied immediately to the bottoms of the containing vessels, is now used.

In dying, for instance, and in brewing; and in the processes of many other arts and manufactures, the adoption of this method of applying heat would be attended not only with a great saving of labour and of fuel, but also of a considerable saving of expense in the purchase and repairs of boilers, and of other expensive machinery: for when steam is used instead of fire for heating their contents, boilers may be made extremely thin and light; and as they may easily be supported and strengthened by hoops and braces of iron, and other cheap materials, they will cost but little, and seldom stand in need of repairs. To these advantages we may add others of still greater importance: boilers intended to be heated in this manner may, without the smallest difficulty, be placed in any part of a room, at any distance from the fire, and in situations in which they may be approached freely on every side. They may moreover easily be so surrounded with wood, or with other cheap substances, which form warm covering, as most completely to confine the heat within them, and prevent its escape. The tubes by which the steam is brought from the principal boiler (which tubes may conveniently be suspended just below the cieling of the room) may in like manner, be covered, so as almost entirely to prevent all loss of heat by the surfaces of them; and this to whatever distances they may be made to extend.

In suspending these steam tubes, care must, however, be taken to lay them in a situation *not perfectly harizontal* under the cieling, but to incline them at a small angle, making them rise gradually from their junction with the top of a large vertical steam-tube, connecting them with the steam-boiler, quite to their furthest extremities: for, when these tubes are so placed, it is evident that all the water formed in them, in consequence of the condensation of the steam in its passage through them, will run backwards, and fall into the boiler, instead of accumulating in them, and obstructing the passage of the steam, which it would not fail to do were there any considerable bends or wavings, upwards and downwards, in these tubes, or of running forward, and descending with the steam into the vessels containing the liquids to be heated, which would happen if these tubes inclined *downwards* instead of inclining upwards, as they recede from the boiler.

In order that clear and distinct ideas may be formed of the various parts of this apparatus, even without figures, I shall distinguish each part by a specifick name: the vessel in which water is boiled in order to generate steam, and which, in its construction, may be made to resemble the boiler of a steam-engine, I shall call the *steam-boiler:* the vertical tube, which, rising up from the top of the boiler, conveys the steam into the tubes (nearly horizontal) which are suspended from the ceiling of the room, I shall call the *prime conductor;* to the horizontal tubes I shall gives the name of *horizontal conductors*, or simply *conductors of steam;* and to the smaller tubes, which, descending perpendicularly from these *horizontal conductors*, convey the steam to the liquids which are to be heated, I shall, exclusively, appropriate the appellation of *steam tubes.*

The vessels in which the liquids are put that are to be heated, I shall call the *containing vessels.*—These vessels may be made of any form; and, in many cases, they may, without any inconvenience, be constructed of wood, or of other cheap materials, instead of being made of costly metals, by which means a very heavy expense may be avoided.

Each *steam tube* must descend perpendicularly from the *horizontal conductor* with which it is connected to the level of the bottom of the *containing vessel* to which it belongs; and, moreover, must be furnished with a good brass cock, perfectly steam-tight; which may best be placed at the height of about six feet above the level of the floor of the room.

This *steam tube* may either descend *within the vessel* to which it belongs, or *on the outside of it*, as shall be found most convenient. If it comes down on the outside of the vessel, it must enter it at its bottom, by a short horizontal bend; and its junction with the bottom of the vessel must be well secured, to prevent leakage. If it comes down into the vessel, on the inside of it, it must descend to the bottom of it, or at least to within a very few inches of the bottom of it; otherwise the liquid in the vessel will not be uniformly and equally heated.

When the steam tube is brought down on the inside of the containing vessel, it may either come down perpendicularly, and without touching the sides of it, or it may come down on one side of the vessel, and in contact with it.

When several steam tubes, belonging to different containing vessels, are connected with one and the same horizontal steam conductor, the upper end of each of these tubes, instead of being simply attached by soldering to the under side of the conductor, must enter at least one inch within the cavity of it ; otherwise the water resulting from a condensation of a part of the steam in the conductor, by the cold air which surrounds it, instead of finding its way back into the steam boiler, will descend through the steam tubes and mix with the liquids in the vessels below ; but when the open ends of these tubes project upwards within the steam conductor, though it be but to a small height above the level of its under side, it is evident that this accident cannot happen.

It is not necessary to observe here, that, in order that the ends of the steam tubes may project within the *horizontal conductor*, the diameters of the former must be considerably less than the diameter of the latter.

To prevent the loss of heat arising from the cooling of the different tubes through which the steam must pass in coming from the boiler, all those tubes should be well defended from the cold air of the atmosphere, by means of warm covering; but this may easily be done, and at a very trifling expense. The horizontal conductors may be enclosed within square wooden tubes, and surrounded on every side by charcoal dust, fine sawdust, or even by wool ; and the steam tubes, and prime conductor, may be surrounded, first by three or four coatings of strong paper, firmly attached to them by paste or glue, and covered with a coating of varnish, and then by a covering of thick coarse cloth. It will likewise be advisable to cover the horizontal conductors with several coatings of paper, for if the paper be put on to them while it is wet with the paste or glue, and if care be taken to put it on in long slips or bands, wound regularly round the tube in a spiral line, from one end of it to the other, this covering will be useful, not only by confining more effectually the heat, but also by adding very much to the strength of the tube, and rendering it unnecessary to employ thick and strong sheets of metal in the construction of it.

However extraordinary and incredible it may appear, I can assert it as a fact, which I have proved by repeated experiments, that if a hollow tube, constructed of sheet copper one twentieth of an inch in thickness, be covered by a coating only twice as thick, or one-tenth of an inch in thickness, formed of layers of strong paper, firmly attached to it by good glue, the strength of the tube will be *more than doubled* by this covering. I found by experiments, the most unexceptionable and decisive—of which I intend at some future period to give to the publick a full and detailed account, that the strength of paper is such, when several sheets of it are firmly attached together with glue, that a solid cylinder of this substance, the transverse section of which should amount to only one superficial inch, would sustain a weight of 30,000 lb. avoirdupois, or above 13 tons, suspended to it, without being pulled asunder or broken. The strength of hemp is still much greater, when it is pulled equally, in the direction of the length of its fibres. I found, from the results of my experiments with this substance, that a cylinder of the size above mentioned, composed of the straight fibres of hemp, glued together, would sustain 92,000 lb. without being pulled asunder.

A cylinder, of equal dimensions, composed of the strongest iron I could ever meet with, would not sustain more than 66,000 lb. weight; and the iron must be very good not to be pulled asunder with a weight equal to 55,000 lb. avoirdupois.

I shall not, in this place, enlarge on the many advantages that may be derived from a knowledge of these curious facts. I have mentioned them now in order that they may be known to the publick; and that ingenious men, who have leisure for these researches, may be induced to turn their attention to a subject, not only very interesting on many accounts, but which promises to lead to most important improvements in mechanicks.

I cannot return from this digression without just mentioning one or two results of my experimental investigations relative to the force of cohesion, or strength of bodies, which certainly are well calculated to excite the curiosity of men of science.

The strength of bodies of different sizes, *similar in form*, and composed of the *same substance*,—or the forces by which they resist being pulled asunder by weights suspended to them, and acting in the direction of their lengths, *are not in the simple ratio of the areas of their transverse sections*, or of their *fractures*;—but in a higher ratio;—and this ratio is different in different substances.

The *form* of a body has a considerable influence on its strength, *even when it is pulled in the direction of its length.*

All bodies, even the most brittle, appear to be *torn asunder*, or their particles separated, or fibres broken, *one after the other;* and hence it is evident, that that *form* must be most favourable to the strength of any given body, pulled in the direction of its length, which enables the greatest number of its particles, or longitudinal fibres, to be separated to the greatest possible distance, short of that at which the force of cohesion is overcome, before any of them have been forced beyond that limit.

It is more than probable that the apparent strength of different substances depends much more on the number of their particles that come into action before any of them are forced beyond the limits of the attraction of cohesion, than on any specifick difference in the intensity of that force in those substances.

But to return to the subject more immediately under consideration.—As it is essential that the steam employed in heating liquids, in the manner before described, should enter the containing vessel at, or very near its bottom, it is evident that this steam must be sufficiently strong, or elastick, to overcome, not only the pressure of the atmosphere, but also the additional pressure of the superincumbent liquid in the vessel; the steam boiler must, therefore, be made strong enough to confine the steam, when its elasticity is so much increased by means of additional heat, so as to enable it to overcome that resistance. This increase of the elastick force of the steam need not, however, in any case, exceed a pressure of five or six pounds upon a square inch of the boiler, or *one third part*, *or one half*, of an atmosphere.

It is not necessary for me to observe here, that in this and also in all other cases, where steam is used as a vehicle for conveying heat from one place to another, it is indispensably necessary to provide *safety valves* of two kinds; the one for letting a part of the steam escape, when, on the fire being suddenly increased, the steam becomes so strong as to expose the boiler to the danger of being burst by it;—the other for admitting air into the boiler, when, in consequence of the diminution of the heat, the steam in the boiler is condensed, and a vacuum is formed in it; and when, without this valve, there would be danger, either of having the sides of the boiler crushed, and forced inwards by the pressure of the atmosphere from without, or of having the liquid in the containing vessels forced upwards into the horizontal steam conductors, and from thence into the steam boiler. This last mentioned accident, however, cannot happen, unless the cocks in some of the steam tubes happen to be open. The two valves effectually prevent all accidents.

The reader will, no doubt, be more disposed to pay attention to what has here been advanced, on this interesting subject, when he is informed that the proposed scheme has already been executed on a very large scale, and with complete success; and that the above details are little more than exact descriptions of what actually exists.

A great mercantile and manufacturing house at Leeds, that of Messrs. Gott and Company, had the courage, notwithstanding the mortifying prediction of all their neighbours, and the ridicule with which the scheme was attempted to be treated to erect a *dying house*, on a very large scale indeed, on the principles here described and recommended.

On my visit to Leeds the last summer, I waited on Mr. Gott, who was then mayor of the town, and who received me with great politeness, and showed me the cloth halls, and other curiosities of the place; but nothing he showed me interested me half so much as his own truly noble manufactory of superfine woollen cloths. I had seen few manufactories so extensive, and none so complete in all its parts. It was burnt to the ground, the year before I saw it, and had just been rebuilt on a larger scale; and with great improvements in almost every one of its details. The reader may easily conceive, that I felt no small degree of satisfaction on going into the dying house to find it fitted up on principles which I had had some share in bringing into repute, and which Mr. Gott told me he had adopted in consequence of the information he had acquired in the perusal of my *seventh* essay. He assured me that the experiment had answered, even far beyond his most sanguine expectations; and, as a strong proof of the utility of the plan, he told me, that his next door neighbour, who is a dyer by profession, and who, at first, was strongly prejudiced against these innovations, has lately adopted them, and is now convinced that they are real improvements. Mr. Gott assured me that he had no doubt but that they would be adopted by every dyer in Great Britain in the course of a very few years.

The dying house of Messrs. Gott and Company, which is situated on the ground floor of the principal building of the manufactory, is very spacious, and contains a great number of coppers of different sizes; and as these vessels, some of which are very large, are distributed about promiscuously, and apparently without any order in their arrangement, in two spacious rooms, each copper appearing to be insulated, and to have no connexion whatever with the others, all of them together form a singular appearance. The rooms are paved with flat stones, and the brims of all the coppers, great and small, are placed at the same height, about three feet, above the pavement, some of these coppers contain upwards of 1800 gallons; and they are all heated by steam from one steam boiler, which is situated in a corner of one of the rooms.

The horizontal tubes which serve to conduct the steam from the boiler to the coppers are suspended just below the ceiling of the rooms: they are made—some of lead, and some of cast iron; and are from four to five inches in diameter; but when I saw them, they were naked, or without any covering to confine the heat. On my observing to Mr. Gott that coverings for them would be useful, he told me that it was intended that they should be covered, and that coverings would be provided for them.

The vertical *steam tubes*, by which the steam passes down from the horizontal *steam conductors* into the coppers, are all constructed of lead, and are from three fourths of an inch to two and a half inches in diameter; being made larger or smaller, according to the sizes of the coppers to which they belong. These steam tubes all pass down on the *outsides* of their coppers, and enter them horizontally at the level of their bottoms. Each copper is furnished with a brass cock, for letting off its contents; and it is filled with water from a cistern at a distance, which is brought to it by a leaden pipe. The coppers are all surrounded by thin circular brick walls, which serve not only to support the coppers, but also to confine the heat.

The rapidity with which these coppers may be heated, by means of steam, is truly astonishing. Mr. Gott assured me that one of the largest of them, containing upwards of 1800 gallons, when filled with cold water from the cistern, requires no more than *half an hour* to heat it till it actually boils! By the greatest fire that could be made under such a copper, with coals, it would hardly be possible to make it boil in less than an hour.

It is easy to perceive, that the *saving of time* which will result from the adoption of this new mode of applying heat will be very great; and it is likewise evident, that it may be increased, almost without limitation, merely by augmenting the diameter of the steam tube; care must, however, be taken that the boiler be sufficiently large to furnish the quantities of steam required. The saving of fuel will also be very considerable. Mr. Gott informed me, that, from the best calculation he had been able to make, it would amount to near two-thirds of the quantity formerly expended, when each copper was heated by a separate fire.

But these savings are far from being the only advantages that will be derived from the introduction of these improvements in the management of heat: there is one, of great importance indeed—not yet mentioned—which alone would be sufficient to recommend the very general adoption of them.—As the heat communicated by steam can never exceed the mean temperature of boiling water by more than a very few degrees the substances exposed to it can never be injured by it. In many arts and manufactures this circumstance will be productive of great advantages, but in none will its utility be more apparent than in cookery; and especially in publick kitchens, where great quantities of food are prepared in large boilers; for, when the heat is conveyed in this manner, all the labour now employed in stirring about the contents of those boilers, to prevent the victuals from being spoiled by the burning to the bottoms of them, will be unnecessary; and the loss of heat occasioned by this stirring prevented; and, instead of expensive coppers, or metallick boilers, which are difficult to be kept clean, and often stand in need of repairs—common wooden tubs may, with great advantage, be used as culinary vessels; and their contents may be heated by *portable fire places*, by means of steam boilers attached to them.

As these portable fire places and their steam boilers may, without the smallest inconvenience, be made of such weight, form, and dimensions, as to be easily transported from one place to another by two men, and be carried through a door-way of the common width—with this machinery, and the steam tubes belonging to it, and a few wooden tubs, a complete publick kitchen, for supplying the poor and others with soups, and also with puddings, vegetables, meat, and all other kinds of food prepared by *boiling*, might be established in half an hour, in any room, in which there is a chimney by which the smoke from the portable fire-place can be carried off; and, when the room should be no longer wanted as a kitchen, it might, in a few minutes, be cleared of all this culinary apparatus, and made ready to be used for any other purpose.

This method of conveying heat is peculiarly well adapted for heating baths: it is likewise highly probable that it would be found useful in the bleaching business, and in washing linen. It would also be very useful in all cases where it is required to keep any liquid at about the boiling point for a long time without making it boil; for the quantity of heat admitted may be very nicely regulated by means of the brass cock belonging to the steam tube. Mr. Gott showed me a boiler in which shreds of skins were digesting in order to make glue, which was heated in this manner; and in which the heat was so regulated, that, although the liquid never actually boiled, it always appeared to be upon the very point of beginning to boil

This temperature had been found to be best calculated for making good glue. Had any other *lower* temperature been found to answer better, it might have been kept up with the same ease, and with equal precision, by regulating properly the quantity of steam admitted.

I need not say how much this country is obliged to Mr. Gott, and his worthy colleagues. To the spirited exertions of such men—who abound in no other country—we owe one of the proudest distinctions of our national character: that of being an enlightened and an enterprising people.

## REMARK BY T. G. F.

The mode heating water by steam above described, should be adopted in preparing skins for tanning, as described by Mr. Martin, see pages 17 and 18, and for macerating hemp as described pages 27, 28, and many other processes.

# METHOD OF HEATING ROOMS BY STEAM.

BY MR. NEIL SNODGRASS, OF RENFREW.—TRANS. SOC. ARTS. VOL. 24.

MR. SNODGRASS having been engaged to manage a cotton-mill in a part of Scotland where fuel was scarce, was induced to try the effect of steam for warming the air of its different apartments (from observing the method of drying muslins by wrapping them round hollow cylinders heated by steam, which was practised near Glasgow) both on account of the saving of fuel it would produce, and its removing all danger of conflagration, to which mills, heated in the usual manner, are most exposed.

He put this method in practice at a mill at Dornach, with such success as to heat it completely with one *half* the fuel, that would be necessary for this purpose with the best constructed stoves, but as the apparatus for this mill was not as perfect as that afterwards contrived, it need not be here detailed.

Two cotton mills belonging to G. Houston, Esq. of Johnstone, were also warmed by steam; in one of these, six stories high, a lying pipe of cast iron, 5 inches in diameter, is carried along the middle of the ceiling of the lower story, about two feet from the ceiling, with a small declivity to carry off the water. This pipe heats the lower story, and from it arise tin pipes of 7½ inches in diameter, at intervals of 7 feet from each other, which, passing perpendicularly upwards through all the floors in the mill, form a line of heated columns in the middle of each room. In the other mill this plan has received some alterations on account of the irregularity of the building. Valves opening inwards were added to the tin pipes, to prevent their compression by accidental condensation of the steam; and another valve was placed opening outwards at the lower part of the apparatus to permit the air contained in the pipes to pass as its place was occupied by steam.

Certificates of five other mills being heated in the same manner, to great advantage, by Mr. Snodgrass, were received by the Society for Arts, &c.

In new manufactories, where the mode of heating may be made an original part of the plan, Mr. Snodgrass recommends an apparatus, of which the following is a description:

Vertical pipes of cast iron, about 7 inches in diameter in the lower stories, and 6 inches diameter in the upper stories, ascend from the bottom to the top of the mill in the middle of the apartments, at about 7 or 8 feet distance from each other. These pipes come close to the beams in each story, and are contrived so as to support them by projecting pieces, like brackets, cast to them in the proper places, which go under the beams; and by wedges driven between them and the beams, each can be made to have a due bearing; and thus these pipes perform the double office of steam flues, and of pillars to support the mill-floors.

The joints of the pipes, are each of the length of the height of the story where it is placed, and fit into each other by a projecting socket at the place of contact, which is stuffed in the intervals so as to be steam tight. These vertical pipes all communicate at top with a smaller horizontal pipe, which passes to the open air through the wall, where it has a valve fitted to it opening outwards, to admit the air to pass, contained at first in the pipes; the vertical pipes all communicate at the bottom with a small horizontal copper pipe gently inclined towards the boiler, with a valve for the same purpose as that just mentioned at its upper end, outside the building, and an inverted syphon at the other end, over a hot well, from whence the boiler is supplied with water, and into which all the hot water runs, that is formed by the condensation of the steam in the pipes. The boiler is outside the building, and communicates with the first vertical pipe near the top of the ground floor, by an inclined pipe passing through the wall from its upper part; the steam ascends through the first vertical pipe, in this apparatus, then enters the horizontal pipe at the top, from whence it descends into all the vertical pipes, forcing out the air before it as it proceeds.

The boiler, for a mill 60 feet long and 33 feet wide, is 6 feet long, 3½ broad, and 3 deep, it is fed, and managed in the usual manner; but the smoke from its fire place, after passing through a short level brick flue, ascends into a cast metal pipe enclosed in a vertical brick flue, in the gable of the building; from which brick flue, small openings are made into each story a few feet above the floor; and another opening being made in it near the ground outside, a current of air heated by the iron smoke pipe, passes from below into every apartment. The air passages may have the space of their apertures regulated by registers; and as the iron smoke pipe does not touch the fire, having a short brick flue intervening, and consequently can never be heated so as to be liable to crack, or in any other way transmit inflamed substances to the mill, there can be little or no danger of fire, while this part of the plan still further economises the heat.

The strength of the pipes, which are 3-8ths of an inch thick, render unnecessary valves opening inwards, as the pressure of the atmosphere cannot damage them.

This apparatus will heat the air in the rooms to 85° in the coldest season; and it is evident, that by increasing the number of pipes, and the supply of steam, any heat under 212°. may be produced.

The Society of Arts voted Mr. Snodgrass 40 guineas, or the gold medal, at his option, for this communication.

The merit of Mr. Snodgrass in the described apparatus, consists in judicious application of well known principles, not in invention; for count Rumford, had several years ago, heated rooms by steam conveyed by pipes, as may be seen in his publication on this subject, inserted in the Repository of Arts, vol. 15. p. 186. and elsewhere.*

Mr. Green, of Wandsworth, also, in 1793, obtained a patent for warming rooms by air heated with steam; but his method had not the same similarity to that of Mr. Snodgrass, which count Rumford's possesses.

## SUBSTANCE

### OF THE SPECIFICATION OF A PATENT, GRANTED TO SAMUEL BENTHAM, ESQ. OF QUEEN-SQUARE, WESTMINSTER; FOR A NEW METHOD OF PERFORMING AND FACILITATING THE BUSINESS OF DIVERS MANUFACTURING AND ECONOMICAL PROCESSES. REPERTORY OF ARTS.

THIS patentee informs us that his invention consists in extracting and excluding the air in the way of philosophical experiment. Air, he informs us, although so necessary in the ordinary functions of life, is either known or suspected to be an obstacle to the arts and

* The preceding article, in this work is what is here referred to.

manufactures in a great variety of ways. It is an obstacle to preservation, to separation, as in distillation, to the effectuation of contact, to intromission, impregnation, transmission and percolation, mixture or the regulation of heat. The patentee then proceeds to show in what way the presence of air may be an obstacle to the end in view, and thence in what ways advantage may be reaped from its exclusion and extraction.

1. *Preservation, in point of substance.* There are few substances, but what are subjected to certain alterations by the action of atmospherick air, and which may, so far as that is the case, be prevented by its extraction and exclusion. Such as the putrefaction of animal and vegetable substances, the alteration which causes rancidity in oil, the rusting of metals, &c. The practice of putting animal substances in fat, owes its preserving quality, in good measure to the exclusion of air, by means of the fat insinuating itself into all the vacuities, and wherever, by an air pump or otherwise, the air can be perfectly extracted from such vacuities, a degree of preservation as perfect as in the former case may be expected.

*Preservation in point of colour.* Many of the changes to which bodies are subject, in point of colour, are known to result from the action of air. An exhausted chamber might prevent tarnishing and fading.

2. *Distillation.* The greater the quantity of air in the still, the greater the pressure upon the substance whence the distillation is to be performed, and the greater the quantity of the heat necessary to enable the substance to assume an elastick state. Extract the air from the whole of the inclosed space (still and receiver) you subtract from the pressure and diminish the quantity of heat necessary for distillation.

7. *Mixture of fluid masses with powders, or heaps of small sized bodies*, may be accelerated by the extraction of air. For example, mixing malt or grain with water, for the purpose of brewing, may be rendered comparatively instantaneous. Likewise the mixture of water with lime, plaster of Paris, or other powders, for making mortar or stucco; the mixture of oils with different powders for glaziers' putty, and paints.

8. *Regulation of heat.* By the process of distillation, when carried on in vacuo, means are afforded of producing a balneum, by which any degree of heat may be maintained at pleasure, and continued for any length of

time, from a degree somewhat higher than the lowest at which the liquid can be made to distil in vacuo, up to any degree less than that which would cause the vapour or steam to burst the still. For this purpose, conceiving the contents of the still to constitute the balneum, nothing more is necessary than to stop the passing of the vapour out of the still into the condenser, by a valve so loaded with weights, or impeded by other means as to confine the vapour till it has acquired the intended degree of heat. By means of the extension thus given to the scale of temperature by the removal of air; a balneum of regulated heat will be produced, which will be applicable to a variety of objects of a chymical and mechanical kind; for instance preserving clock work from the irregularities, to which, under the ordinary fluctuations of temperature it is exposed.

9. *Exsiccation.* Distillation *in vacuo* may be applied in some cases with advantage to the purpose of separating fluids from solids, and thereby drying wood and other substances.

Several of these operations being such as to require a larger vacuum than can be made in a common air pump, it may be useful to show how an apparatus may be constructed to fit the purposes of this patent.

The vacuum chamber will be regulated by the scale on which it is proposed to operate. It may be of the size of a large room like the vessels of a large brewery. It should be no larger than is absolutely necessary to facilitate the extraction of the air, and it may be of advantage to adapt the form of the chamber to that of the subject to be contained in it. To enable the operator to see the processes as they go on, the chamber may have glass windows in it, but the glass must be thick to enable it to resist the pressure of the air, and must be fitted in the closest manner. Whatever apertures the particular process in view may require, should be made as small as possible.

For the accomplishment of such a variety of objects a variety of machinery may be found necessary, as in all or most of these cases the source of motion must be exposed to the external atmosphere; while the subject to be operated upon will be in the vacuum chamber. The methods already in use, such as the collar of leather, will, in general be found sufficient. A spindle, sliding in such a collar, gives rectilinear motion: a spindle turning round on its axis gives circular motion: from one or the other of these two, or from either of them, any other motions may be produced. Agitation or pressure, by stampers, rollers, or screws may serve for examples. The friction that may appear essential to such a communication, will render it advisable that the motion, in its first stage, be slow; but within the chamber any degree of quickness may be obtained by the well known contrivances of acceleration. So much of the friction as depends on the pressure of the external air may be got rid of, by substituting to the pressure of a close fitting collar that of a column of mercury, of a heighth sufficient to counterbalance the greatest weight of a column of the atmosphere, forming an annular stopple in which the axis of communication plays.

To facilitate the extrication of air from bodies in different states, different operations may become requisite.

When the body is of an adhesive nature, the particles of an inferiour stratum of it may be forced together, by the pressure of the superiour stratum, in such manner as to form a kind of cells in which small masses of air may be pent. In proportion as a mass is thus disposed to keep air entangled in it, it is necessary in order to extricate the air, to break up the whole mass. This may be done by making the mass, in its way from the vessel that contains it to the vacuum chamber pass in a highly divided state: for instance through a cullender, or sieve, or filtering stone. If the mass is too viscous to be thus treated, butter for instance, it may be kneaded with a kind of stampers; or the whole be forced through slits or holes, like vermicelli or maccaroni; or passed between rollers, spreading it into ribbands of any degree of thinness. From the apparatus thus employed in the commination, the subject matter, at the close of the operation may fall into the vessel (a cask for example) in which it is to be packed. The path of its descent may be inclined, in order to leave room for a perpendicular descent for the pressure. This pressure may be performed for example, by a kind of stamper or piston, so ordered that the frequency of its descent shall correspond with the rate at which the cask is fed as above. When the cask is thus fed the cover being conveyed, by a movement within the chamber, to the top of the cask, may then be pressed down upon the cask by the same apparatus with which the mass is pressed in; leaving the fastening to be secured at leisure by screws or otherwise, after the chamber has been opened, but before the pressure has been removed. If the subject matter is small masses of a yielding nature, for example in the form of minced meat, more or less dried, it may be discharged into the cask by tilting, for example, from a vessel of larger content suspended above the cask; the rate of feeding being regulated as before, in correspondence with the strokes of the pressing machine. The use of the packing thus close is partly to prevent the air from insinuating itself into the mass through the vessel, so that an ordinary cask may suffice; partly to prevent the component parts of the cask from being unequally forced in by the pressure of the atmosphere; partly to prevent the air from re-insinuating itself into the mass, when the package is opened for use; and partly to save stowage.

To assist perfecting the business of cementation by the exclusion of air, it may be of use that the operation of applying the cement should be performed in the vacuum chamber itself, after the air has been extricated from the pores of the substance into which the cement is intended to be introduced. Thus for the gluing of two boards together, for example one may be flat upon the bottom of the vacuum chamber; the other remaining suspended directly over it, and at such a distance above it, as there be sufficient room to admit a brush to apply itself between them. This brush may either have been previously impregnated with the glue, or it may contain in the handle, for example, a reservoir of the fluid, which may be discharged when wanted.

In many cases of impregnation and transmission, the fluid which it is intended should be forced through or into the subject matter, finds its intended place already occupied by another fluid, which it must consequently drive out. In these cases an advantageous way of effecting the exchange is, so to order matters, that the inclosure of the subject matter in the vacuum chamber shall be partial only, leaving one part exposed to the pressure of the external atmosphere, with no other covering than that of the impregnating fluid: suppose, for example, a skin is to be impregnated with the liquids respectively used for tanning and currying; at the top the materials for the vacuum chamber instead of being air tight, are of a permeable texture, in the manner of a sieve, of a convenient degree of fineness, with a support of a strength proportioned to its extent, and composed, for instance, of bars, or grating: upon this sieve, the skin being stretched, is covered with the fluid. The figure of the skin, however, being irregular, will never exactly cover the whole of the permeable part of the chamber ; if it is equally extensive in its greatest dimensions, it will fall short in other places. This deficiency must be supplied by another cover impermeable to air, such as oiled silk, leather, or some ductile cement; which supplemental covering must be made to apply itself as exactly as possible to the edge of the skin, that the air may find little or no space at which it can insinuate itself between them.

It is scarce necessary to observe, that wherever air is intended to be extricated, gradually or at successive periods, the operation of exhaustion will require to be continued or repeated.

## REMARKS BY T. G. F.

I believe that some of the processes above described have been adopted, and found useful in England. It is obvious that instead of the "vacuum chamber," an occasional vacuum might be formed. For instance, the air might be exhausted from a tanner's vat covered over the top, and made air tight, by a simple apparatus, like that which is employed in exhausting the air from an air pump. Dyers tubs or vats, likewise may be easily exhausted of air, and I think that the process of colouring yarn and cloth has been facilitated by that means, in England. In some instances, however, it may be, that the presence of air is necessary in order to bring about the *chymical changes*, which take place in bodies like those which are described as the subjects of the above patent. Thus skins to be tanned, would, undoubtedly more speedily imbibe the ooze or liquor, which contained the tannin, if the air was previously exhausted from the pores of such skins. But whether the presence of air, or the oxygen which it contains may not be necessary in order to bring about the chemical change, to which the skins are subjected, experiments must decide. I think, however, that the above will furnish useful hints for students in philosophy, relative to the employment of the common air-pump, as most of the bodies described by Mr. Bentham, may on a small scale be subjected to the operation of such air pumps as are used in our colleges, and other seminaries of literature and science.

## MIX'S MAIN SPRING FOR CARRIAGES.

THE subscriber obtained letters patent of the United States on the 18th of April, 1807, for a main spring or springs for pleasure or other carriages; a description of which here follows, viz.

The spring is placed on the centre of the axletree, running parellel with it, and is fastened to it by two bolts put through the spring and axletree, with nuts to each lower end of the bolts, to be placed about four inches apart, each end of the spring gradually rising in a circular manner until each end will be four or six inches from the upper side of the axletree, and extend to one inch beyond the outside of the shafts. The shafts of the carriage are placed on each end of the spring, a bolt is placed through the shaft, the spring, axletree and brace, with a nut on the lower end of each bolt, also two bolts or bars running from each shaft to the brace on each side of the axletree.

A specification of the superiority of the same in preference to all other now in use is herewith presented as follows, viz.

First, They are more safe, easy, and convenient, and can be afforded at half the value of the former old steel springs.

Secondly, Safer on this account; should the main spring by any unforeseen accident give way, the rider will not be in any danger, as the carriage will not settle down more than four or six inches, before it will rest safe on the axletree of the carriage, and may proceed on a journey without any risk, until a convenient opportunity presents to have it repaired.

Thirdly, As the shafts of the carriage are placed on each end of the main spring, whenever the wheel strikes a stone, or any other obstruction, and the wheel rises, the spring plays to the motion and eases the carriage and the riders, in a pleasant and agreeable manner, and will scarcely be perceivable.

Fourthly, The weight of the carriage with its load centering on the middle of its axletree, is a very great defence against oversetting; whereas, those carriages with high and heavy springs, placed on the top of the shafts before and behind, have a great tendency to overset, and have often been detrimental to the lives and property of many.

Fifthly, A carriage completed with this main, or axletree spring, is much easier for a horse in his travelling up or down hill; for the carriages now in use, with the high steel springs on the shafts behind, the weight being so great, takes all the weight from the horse's back in his travelling up hill, and presses very hard upon his back when going down hill which is intirely prevented by this main, or axletree spring, whereby the strength of the horse is assisted, and a great loss of flesh prevented.

Sixthly, The main or axletree springs, are preferable to others, on account that they can be afforded at least at half the expense of the high steel springs, and thereby put a stop to the importation of the former steel springs, and in that way be a saving of some thousands of dollars to the United States.

Seventhly, The main or axletree springs are preferable to the other kinds now in use. The carriages for this kind of springs are much more simple and compact, consisting of only the shafts and four bars, making a strong frame; and having no weight of springs on them, they will keep their places and wear much longer without the necessity of any repairs.

The subscriber would respectfully inform the publick, that he has now on hand a number of carriages fitted with those main or axletree springs, which are now ready for sale or the inspection of all those who wish to have occular demonstration of the excellence of the main or axletree spring. He would also inform them that he is willing to dispose of patent rights to states, districts, counties, or towns, throughout the union, and that he now has a number of springs for sale.

All which is respectfully suomitted to the publick, by the patentee.

JONATHAN MIX.

# ACCOUNT OF A METHOD

## OF PREVENTING THE PREMATURE DECAY OF FRUIT TREES.* BY JOHN ELLIS, OF NEW JERSEY.

FROM THE TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE decay of peach trees is owing to a worm, which originates from a large fly, that resembles the common wasp: this fly perforates the bark, and deposits an egg in the moist or sappy part of it. The most common place of perforation is at the surface of the earth, and, as soon as the worm is able to move, it descends into the earth, probably from an instinctive effort to avoid the winter's frost. This may be ascertained by observation, the track of the worm from the seat of the egg being visible at its beginning, and gradually increasing, in correspondence with the increasing size of the worm; its course is always downwards. The progress of the young worm is extremely slow; and if the egg is deposited at any considerable distance above the surface of the earth, it is long before the worm reaches the ground. The worms are unable to bear the cold of winter unless covered by the earth, and all that are above ground after frost are killed.

By this history of the origin, progress and nature of the insect, we can explain the effects of my method, which is as follows. In the spring, when the blossoms are out, clear away the dirt so as to expose the root of the tree, to the depth of three inches: surround the tree with straw, about three feet long, applied lengthwise, so that it may have a covering one inch thick, which extends to the bottom of the hole, the but-ends of the straw resting upon the ground at the bottom. Bind this straw round the tree with three bands, one near the top, one at the middle, and the third at the surface of the earth; then fill up the hole at the root with earth, and press

* This and the following paper having been transmitted by candidates for the premium which was offered by the American Philosophical Society, "for the best method of preventing the premature decay of Peach Trees," were considered as very deserving of publick attention. It was therefore determined that the premium of sixty dollars should be divided between their respective authors.

it closely round the straw. When the white-frosts appear, the straw should be removed, and the tree should remain uncovered until the blossoms put out in the spring.

By this process the fly is prevented from depositing its egg within three feet of the root, and although it may place the egg above that distance, the worm travels so slow that it cannot reach the ground before frost, and therefore is killed before it is able to injure the tree.

The truth of the principle is proved by the following fact. I practised this method with a large number of peach trees, and they flourished remarkably, without any appearance of injury from the worm, for several years. I was then induced to discontinue the straw with about twenty of them. *All those which are without the straw have declined, while the others, which have had the straw, continue as vigorous as ever.*

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## DESCRIPTION OF A METHOD

OF CULTIVATING PEACH TREES, WITH A VIEW TO PREVENT THEIR PREMATURE DECAY; CONFIRMED BY THE EXPERIENCE OF FORTY FIVE YEARS, IN DELAWARE STATE, AND THE WESTERN PARTS OF PENNSYLVANIA. BY THOMAS COULTER, ESQUIRE, OF BEDFORD COUNTY, PENNSYLVANIA.

FROM THE TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE death of young peach trees is principally owing to planting, transplanting, and pruning *the same stock*, which occasions it to be open and tender, with a rough bark, in consequence of which insects lodge and breed in it, and birds search after them, whereby wounds are made, the gum exudes, and in a few years the tree is useless. To prevent this, transplant your trees as young as possible, if in the kernel it will be best, as there will then be no check of growth. Plant them sixteen feet apart. Plow and harrow between them, for two years, without regard to wounding them, but avoid tearing them up by the roots. In the month of March or April, in the third year after transplanting, cut them all off by the ground, plow and harrow among them as before, but with great care, to avoid wounding or tearing them. Suffer all the sprouts or scions to grow, even if they should amount to half a dozen or more, they become bearing trees almost instantaneously, on account of the strength of the root. Allow no animals but hogs to enter your orchard, for fear of their wounding the shoots, as a substance drains away through the least wound, which is essential to the health of the tree, and the good quality of the fruit.

If the old stock is cut away the third year after transplanting, no more shoots will come to maturity than the old stump can support and nourish, the remainder will die before they bear fruit, and may be cut away, taking care not to wound any other stock. The sprouts when loaded with fruit will bend, and rest on the ground in every direction for many years, all of them being rooted as if they had been planted, their stocks remaining tough, and their bark smooth, for twenty years and upwards. If any of the sprouts from the old stump should happen to split off and die, cut them away, they will be supplied from the ground by others, so that you may have trees from the same for 100 years, as I believe. I have now trees from one to thirty-six years old, all from the same stump. Young trees, formed in this manner, will bear fruit the second year; but this fruit will not ripen so early as the fruit on the older trees from the same stump. Three years after the trees are cut off, the shoots will be sufficiently large and bushy to shade the ground so as to prevent the growth of grass, that might injure the trees: therefore ploughing will be useless, and may be injurious by wounding them. It is also unnecessary to manure peach trees, as the fruit of manured trees is always smaller and inferiour to that of trees which are not manured. By manuring you make the peach trees larger, and apparently more flourishing, but their fruit will be of a bad kind, looking as green as the leaves, even when ripe, and later than that of trees which have not been manured. Peach trees never require a rich soil: the poorer the soil the better the fruit: a middling soil produces the most bountiful crop. The highest ground is the best for peach trees, and the north side of hills is most desirable, as it retards vegetation, and prevents the destructive effects of late frosts, which occur in the month of April, in Pennsylvania. Convinced, by long experience, of the truth of these observations, the author wishes they may be published for publick benefit, and has been informed, that colonel Luther Martin and another gentleman, in the lower part of Maryland, have adopted a similar plan with great advantage.

## REMARK BY T. G. F.

' The method here described of managing peach trees will probably supply some useful hints for the culture of apple and other fruit trees. Old orchards might be renewed by cutting away in the proper season the old stocks, and leaving the most vigorous sprout to renew the stock, or making use of the stump to ingraft upon; if the fruit be not of the best quality. New varieties of fruit, however, ought to be occasionally sought for from the seeds, as ingrafted fruits in process of time degenerate. A valuable paper on this latter subject may be found in the Transactions of the Society for the Encouragement of Arts, Manufactures and Commerce, written by Thomas Skyp Dyot Bucknall, Esquire, and republished in the Repertory of Arts. 2d Series, vol. 2. p. 361.

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## BURNING STUBBLE.

BY MR. W. CURTIS.—COM. BD. AGR. 1805.

MR. W. CURTIS, of Lynn, Norfolk, found very beneficial effects from burning the stubble of oats, which was left eighteen inches high for this purpose, on a field broken up from old pasture the same year; he afterwards sowed wheat and oats in succession on the same ground, the stubble of both which was burned in the same manner. The ashes were in every case ploughed in to a small depth, and the verges of the field mowed previous to the burning, to prevent accidents. After the third crop of corn, all of which were abundant and remarkably free from weeds, the field was laid down with clover and grass seeds, and the ensuing crops of both hay and grass proved infinitely finer than those before the ground was broken up.

Another piece of land was cropped for three successive years, in the same manner as the first, to which it was similar in every respect of soil, aspect, and previous management, but in which the stubble was ploughed in, instead of being burned; the produce of each crop on it was much inferiour to that of the first experiment, and the weeds increased so greatly, that on laying it down to grass, they overpowered the grass seeds so much that it was necessary to re-sow it; and ever after, while Mr. Curtis held it, the grass and hay produced were coarse and full of weeds, and consequently inferiour both in value and quantity to those of the other field, on which the stubble had been burned.

## OBSERVATION.

This is an additional proof to those given in the former number of this work, of the meliorating quality of carbonaceous matter to land, and the great benefit of burning, both in producing this matter, and extirpating weeds in the most effectual manner.

## REMARK BY T. G. F.

In burning stubble, the danger which is to be apprehended from the spreading of the flames, may perhaps be obviated by tracing a furrow round the field, and setting fire to the stubble on the inner edge of the furrow.

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## ACCOUNT OF COMMUNICATIONS

### TO THE BOARD OF AGRICULTURE, ON PARING AND BURNING. PUBLISHED, 1805. RET. OF DISC.

THE result of twenty-seven communications to the Board of Agriculture on paring and burning, have been all greatly favourable to this practice. Almost all kinds of soils have been tried in this manner, in various counties in England and Wales. It may be useful to enumerate the different soils mentioned in the reports, some of which soils are of that nature on which the practice has been esteemed most doubtful, and yet on all it was followed by uniform and decided advantage. The soils mentioned are clay, clay and chalk, poor old clay, clay sand and loam, clay moors and heaths, strong wet land, sand, *thin skinned warren*, *poor gravelly heath*, heath, stone brush and light loam, loams, loam gravel and rich land, loam on lime, stone, chalk, chalk heaths, downs, fens, peat, rushy pastures, old pasture, and rough uncultivated ground. The experiment made on this matter by Mr. Wright, of Pickworth, is one of the most remarkable; he broke up sixteen acres of gravelly heath, and though he managed it in the best manner possible, by tillage alone, lost four crops in succession, through the ravages of grubs, wire worms, and other insects, always abundant in uncultivated dry ground; he afterwards broke up twenty-four acres of the same gravelly heath, which he pared and burned, which produced a most plentiful crop of turnips, and another equally good of barley, and remained in the most favourable state for laying down to grass with oats. An experiment on a small scale, made by the reverend G. Swayne, near Bristol, also deserves notice: a lump of ferruginous yellow clay was put into a coal fire till it was red hot; when cold, the outside was red for half an inch in depth, and the inside black; it was then bruised down to the consistence of coarse sand, put in a drinking-glass, and moistened with rain water; some of the unburned earth was placed in a glass, and managed afterwards in the same manner; in both were sown a few grains of wheat and mustard seeds. The seeds in the burned earth vegetated speedily and vigorously, while not a single seed sprouted in the unburned earth.

Most of the reports agree in the benefit derived from the actual heat of the fires to the ground, as well as from the ashes, the spots where the fire lay were uniformly the most fertile, though the ashes were carefully scraped off them; for this reason several recommend to make the heaps small, that they may be the more numerous. The ashes of small heaps were also found to be the most meliorating; the reporters observe that they were always black, while those of the large heaps, where the fire was powerful, were red; which farther confirms what has been mentioned in the former Number of this Work, of the advantage of burning so as to produce the most carbonaceous matter.

## DESCRIPTION OF A BOILER.

INVENTED BY COUNT RUMFORD, PRESENTED TO THE FRENCH NATIONAL INSTITUTE. AIKIN'S ATHENEUM.

THE boiler of the new construction which count Rumford tried was made on a small scale, being a copper cylinder only twelve inches in diameter, and as many in height, closed at top and bottom with circular plates. From the bottom seven tubes projected downward, each nine inches long, and three inches across, open next the cavity of the boiler and closed at their farther extremities; from the top of the boiler a short tube arose, six inches in diameter, and three inches high, shut at the top by a copper plate, through which passed one tube for the safety-valve, another to convey the steam where wanted, and a third to admit water from the reservoir to supply the evaporation; this last tube passed downwards to within an inch of the bottom plate, where it was furnished with a cock and floating ball, that was so placed as to keep the water six inches deep in the cavity of the boiler above that in the tubes. The furnace in which this boiler was placed was of sheet iron three inches high, and seventeen inches in diameter, lined with masonry, which is not particularly described; but as the grate is mentioned to be but six inches in diameter, it is probable that the cavity of the fire-place was of a conical shape from it to the bottom of the seven tubes.

Count Rumford reports that the boiler exceeded his expectation, which of course must have been to produce much steam with little fuel; but no particulars are recited of any experiments made to determine the effect of the boiler in this respect; he supposes that a boiler made in this form would have more strength, in proportion to the surface exposed to the same internal pressure, than one of the usual shape, and that it would be less liable to loss of heat from cold air coming in contact with its external surface.

When a boiler of this kind is constructed on a large scale, the count mentions that the seven descending tubes may be made of cast iron, and the rest of the boiler sheet iron, or copper; and thinks that, when of this construction, it will cost less than one of equal surface of the usual form. But he adds, in corroboration of the result of former experience, that in all cases where it is required to produce a great quantity of steam, it will always be preferable to employ several boilers of a middling size, placed beside each other, and heated each by a separate fire, instead of using one large boiler.

## DESCRIPTION

### OF MR. LLOYD'S PATENT BOILER FOR QUICK BOILING AND SAVING FUEL. AIKIN'S ATHENEUM.

THE bottom of each of Mr. Lloyd's boilers is introverted, so as to form a cavity which would nearly hold as much as the boiler itself, if it were reversed; the sides of this cavity are somewhat conoidal, and from the top a pipe passes out at one side through the cavity of the boiler to the air; the whole boiler or kettle, is surrounded by an external case, a little distant from it all round, closed at top, and having a small opening at the side to give vent to the smoke. The small pipe adds somewhat to the effect, but is not absolutely necessary. For large boilers the cavity at the bottom need not be so large in proportion as that described, if it rises into the boiler, a third of its depth, it will probably be sufficient. The flame and radiant heat of the fuel is reverberated in all directions in the cavity of the hollow bottom, and must have much more effect than what can be produced by its unconfined lateral action against the external sides of a number of upright pipes however well arranged.

## ACCOUNT OF A SUCCESSFUL EXPERIMENT

IN MAKING SOAP BY THE OPERATION OF STEAM, INSTEAD OF AN OPEN FIRE. COMMUNICATED BY COUNT RUMFORD TO THE FRENCH NATIONAL INSTITUTE. AIKIN'S ATHENEUM.

THE steam was conveyed into the vessel, which contained the lie and other materials for the soap, by a pipe arising from a close boiler, and again descending into the vessel; the action of the steam in condensing in the cold lie, occasioned a succession of smart shocks, similar to blows of a hammer, which caused the whole apparatus to tremble, but which gradually subsided as the liquid became warm. Count Rumford supposes, that the beneficial action of the steam depends for the most part on the motion described, caused by it, and therefore proposes dividing the vessel into two parts by a horizontal partition of thin copper, and causing a slow current of cold water to pass through the lower division, and to let the steam into this lower part, when the upper became too hot to admit of a continuation of the strokes from the condensation of the stream: by which means the same motion being continued in the cold water, would be communicated to the hot liquid through the thin partition.

The soap made by the operation of the steam, required only six hours boiling, whereas sixty hours and more are necessary in the ordinary method of making soap.

## WOODEN MATCHES,

INVENTED BY C. L. CADET, SUPERIOUR TO ROPE MATCHES OR PORT FIRES. ANNALES DE CHEMIE, SEPT. 1806.

THE common rope match, impregnated with saltpetre, used for discharging cannon and mortars, requires constant attendance, as it must be unrolled from the staff every hour or oftener: a heavy rain puts it out, and the end beyond the staff is not always steady, which causes delay in firing the piece. On these accounts it is but seldom used, except to carry fire to the field where port fires are used.

The port fires, composed of paper tubes filled with a mixture of sulphur, salt-petre, and a little gunpowder, are very apt to throw off burning particles of saltpetre to a considerable distance, which renders them very dangerous particularly aboard ships, on which account they are usually kept in them in the middle of a tub of water.

Messrs. Proust and Borda had proposed to the Spanish government, to use wooden rods steeped in a solution of nitrate of pot-ash, well dried, instead of the matches described; Mr. Cadet was informed that these rods burned like touchwood, forming a pointed red coal at their ends, and that the trials with them succeeded perfectly, though they had not been adopted. He informed the French minister at war of these circumstances, who directed him to make the necessary experiments to prove the utility of the wooden matches, in conjunction with captain Lespagnol of the artillery.

The experiments were tried with various kinds of wood impregnated with the different nitrates, of pot-ash, of copper, and of lead. Of the woods tried, lime was the best, and next to it birch and poplar; the rods steeped in solution of saltpetre did not succeed; the nitrate of copper corroded the boilers, caused a noxious fume, and was dear. The nitrate of lead was superiour to the other salts in its effects for the purpose wanted, was not attended with any of the defects of the last, and is more easily reducible when in contact with burning charcoal. M. Cadet attributes the inferiority of the salt petre to the large quantity of water of crystallization which it retains.

It was found that square rods burned better than round, as their angles caused the coal in the centre to burn more vividly, and they always terminated in a burning cone two inches long.

A yard of this wooden match will burn for three hours, whereas the port fire will not last more than three or four minutes: the wooden match is strong and easily carried about; the port fire is liable to break, to throw out dangerous sparks in burning, and costs from three pence to four-pence halfpenny: the match confines its fire to itself and costs about three halfpence. The saving, therefore, in the use of these matches must be a most material object added to their other advantages over the port fires; for the wooden match in burning will cost but three halfpence in an hour, and the port fire will cost no less than five shillings in the same time.

The method of preparing the matches which M. Cadet found to be the best, is the following.

The rods after being cut half an inch square, were stored for some months to dry them, and afterwards exposed half a day in a stove heated to 30°. (probably of Reaumer, and may be equal to about 100 Fahrenheits.) They should then be boiled six hours in a bath of nitrate of lead, composed of a quart of water to every pound of the nitrate; which salt is best prepared by pouring 416 parts of nitrick acid at 40°. and of the specifick gravity of 1.386, diluted with 128 parts of water, on 500 parts of litharge in a glass or earthen vessel: which should be heated till the oxide was dissolved, and then filtered and evaporated to dryness.

The matches should, after this, be again carried to the stove and made thoroughly dry, and then be boiled in spirits of turpentine, which should be poured over them in the boiler so as to cover them about an inch; the boiler should be then gently heated, till the oil of turpentine began to boil, but the moment it grew white and rose up, the cover should be put on the boiler, and it should be removed from the fire; the boiling should be repeated three times, which would take about half an hour each time; when cool, the matches should be taken out, well wiped, and again dried in the stove, and they will be fit for use.

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## THEORY OF THE FABRICATION

### OF SULPHURICK ACID, BY MESSRS. DESORMES AND CLEMENT, ANNALES DE CHEMIE, T. 59.

IN this paper the common opinions relative to the operation of the nitre, when burned along with sulphur to produce sulphurick acid, in the usual mode of fabricating this most useful agent in numerous processes of the arts, are shown to be erroneous. It is stated that the nitre cannot increase the temperature of the burning sulphur, to which its efficacy is attributed by some, as the clay and water mixed with them in the process must prevent this effect; and that the supply of oxygen from the nitre, which most suppose to be the cause of its beneficial operation, is too small to convert the sulphurous acid produced into the sulphurick, as nitre, from Davy's experiments, contains but 0.21, of oxygen, while sulphurick acid contains no less than 0.48, oxygen; and the ninth part of nitre, commonly used with the sulphur, could not supply more than a tenth part of this quantity.

The ingenious theory of the authors is founded on the well known property which nitrous acid gas has of attracting oxygen from the atmospherick air, by which it becomes converted into nitrick acid gas. They state, that in the combustion of the sulphur and nitre, sulphurous acid, and nitrous acid gas, are evolved, with water in vapour and some uncombined oxygen. The nitrous acid gas being converted into nitrick acid gas, by attracting oxygen from the air of the chamber, then parts with its oxygen to the sulphurous acid gas, and converts it into sulphurick acid, which the condensation of the aqueous vapour, by the cold of the chamber, causes to fall down. The nitrick acid gas is thus again coverted into nitrous acid gas, and this again attracts more oxygen from the atmospherick air, yields it to the sulphurous acid gas remaining, and thus produces another precipitation of sulphurick acid, but in smaller quantity than the first.

The nitrous acid thus acts as an intermediate substance to attract oxygen from atmospherick air, for the conversion of the sulphurous gas into sulphurick acid: while the aqueous vapour, though not absolutely necessary, assists the process by separating the nitrick from the sulphurick acid, by the commotion which its precipitation causes among the gasses, and by assisting the evolution of the nitrous acid gas; and its utility has been so much perceived that a quantity is now introduced by exhalations from the hearth, besides that arising from the humidity of the mixture.

A caution is given against permitting too much contact between the gasses and the water added, either by admitting too great a quantity, or by the great agitation of a little; as this would occasion the formation of nitrick acid, which retaining its state, would have very little action on the sulphurous gas.

The authors have confirmed this theory by accurate experiments to prove the separate facts stated in it; it promises to be of much utility to the manufacture of sulphurick acid, which is so largely carried on in various parts of this kingdom, as the extent and form of the leaden chambers, and the management of the fire must be influenced by the hypothesis: It also promises according to the authors, the still more important advantage of saving almost the whole of the nitre.

Those chymists who cannot conveniently procure the original work from which this extract is taken, will find it translated in Nicholson's Phil. Jour. No. 71. and we highly recommend the study of it, and further prosecution of the experiments mentioned in it, to all manufacturers of sulphurick acid.

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# METHOD

## OF RENDERING WHITEWASH MADE WITH LIME DURABLE; ALSO, A METHOD OF MAKING A COMPOSITION TO BE USED AS A SUBSTITUTE FOR DRYING OILS. BY GENERAL LEVASSEUR.

FROM THE ANNALES DES ARTS ET MANUFACTURES.

I AM enabled to certify the efficacy of marine salt in fixing whitewash made of lime. In the year 1795, when I was director of the naval artillery at the port of Toulon, I was commissioned to ascertain the utility of a method proposed by the master painter of that port, M. Maquilan, for whitewashing ships between decks, and likewise their holds, in a durable manner, by means of lime. Our report was in favour of this process, which consists in saturating the water in which the lime is slaked with muriate of soda. The whitewash produced by it is very permanent, does not crack, nor come off upon one's hands or clothes. The experiment was made only on wood. It appears, from M. St. Bernard's account, that it succeeded equally well on walls. The same worthy and learned man says, that this is not the case with M. Cadet de Vaux's whitewash, prepared with milk:* which many persons of my acquaintance, who have used it, have found not to answer, as humidity affects that composition very much.

* Published in the 15th volume of the first series of the Repertory of Arts, page 411.

I find in my notes the composition of a liquid mixture, invented in 1795 by the same Maquilan, as a substitute for drying oils, of which the port of Toulon was actually destitute at that period. As I was an eye witness of the preparation and application of this mixture, I can answer for its success.

Take 16 lbs. of spirit of turpentine and 3 lbs. of tallow. First melt the tallow by itself; take the vessel from the fire, pour into it the spirit of turpentine, which must previously be warmed: put the vessel again on the fire, and, after boiling half an hour, proceed to a second operation.

Take 12 lbs. of spirit of turpentine and 12 lb. of dry pitch and tar altogether into the second vessel, and set it on the fire. When the pitch and tar are dissolved, pour the solution into a third vessel together with the first solution of tallow and spirit of turpentine, which must be kept hot for that purpose: set the mixture again on the fire, and boil it for a quarter of an hour; this mixture is then used to grind the colours on marble, for a future supply.

A second solution of spirits and dry pitch and tar is prepared, and put by to dilute the colours ground and prepared as above, when they are wanted for use. Colours thus prepared, are equally applicable for wood or cloth.

Colours mixed up with this composition dry in less than four hours in the shade; but if exposed to the sun, they the following day discover a little viscosity, and stick to the fingers. However, this is only a temporary defect, for in four or five days the composition becomes so dry that the sun cannot afterwards soften it.

White lead and minium cannot be used with this composition, because they become hard the moment you attempt to dilute them; this effect is not produced with ochres, nor with lampblack.

I need not say that I do not communicate this as an economical process, but there may be occasions when the oils generally employed in painting cannot be procured; and it is then fortunate to have a substitute at hand.

It should be observed, that general Levavasseur is not the only one who complains of the whitewash prepared with milk. However, it is certain that M. Cadet de Vaux has himself used it at Franconville, and other places; and we are inclined to think, that in describing the process he has forgot some circumstances that might probably appear of no consequence; some details which he imagined every one capable of supplying. It is well known, that the success of an experiment depends on the complete combination of all its component parts, and that the omission of even the most trifling quantity produces errours in calculation.

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## METHOD

### OF FERMENTING A LARGE BODY OF FLOUR WITH A SMALL QUANTITY OF YEAST. BY MR. JAMES STONE, OF AMPORT, HAMPSHIRE. REPERTORY OF ARTS.

SUPPOSE you want to bake a bushel of bread, and have not more than one tea-spoon full of yeast; put the flour into a kneading trough, and take about three quarters of a pint of warm water, and the tea-spoon full of yeast, which if thick and steady the better; put it into the water, and stir it until it is thoroughly mixed; then make a hole in the middle of the flour large enough to contain two gallons of water; pour in your small quantity of yeast, mixed with water as above; then take a stick, about two feet long, and stir in some of the flour until it is as thick as you would make batter for a pudding: strew some of the dry flour over it, and let it rest for about an hour, for in that time you will find this small quantity raised so that it will break through the dry flour which you shook over it; then pour in about a quart more of warm water, and stir it with your stick as before, and leave it for two hours more; you will find it rise, or break through the dry flour again; then add three quarts or a gallon more of warm water, and stir in the flour again; and in about three or four hours mix up the dough, and cover it warm. In four or five hours more you may put it into the oven, and you will have as light bread as though you had used a pint of yeast. It does not take above a quarter of an hour more time than the usual way of baking: for there is no time lost but that of adding water three or four times. When you find your body of flour spunged large enough, before you put in the rest of the water, you should, with both hands, mix that which is spunged and the dry flour altogether, and then add the remainder of warm water, and your dough will rise the better and easier. The author asserts, that he constantly bakes this way; in the morning, about six or seven o'clock, he begins his first operation; in an hour's time he adds more water; in two hours more a greater quantity; about noon makes up the dough, and about six in the evening it is put into the oven; and that he has always good bread, never heavy, nor bitter. He adds, that the cause of heavy bread is not owing to the smallness of the quantity of yeast used, but to its not being used properly, for yeast is to flour what fire is to fuel—a spark of the latter will kindle a large body by only blowing it up; so a thimble full of the former, by adding warm water to it, will raise or spunge almost any quantity of flour.

Thus heavy bread is not owing to a deficiency in the quantity of yeast used, but to a deficiency of fermentation; for, if the dough is put into the oven before it is ripe, heavy bread is the natural consequence.

In regard to the difference of seasons, he prescribes that in summer the water should be blood warm, and in cold frosty weather as warm as you can bear your hand in it without making it smart; taking care in winter to cover up your dough.

## ON THE BLEACHING POWDER

OF TENANT AND KNOX, OF SCOTLAND. BY M. ALYON.—ANN. CHEM. VOL. 53.

THE discovery of oxygenated muriatick acid by Scheele, has added great light to chymistry. The fine experiments of M. Berthollet on this substance, and his application of it to the arts, are known to all Europe. Nevertheless, his proceedings, as he himself acknowledged, were open to improvement in the bleaching department: how injurious the vapour of this acid is to the workmen when they operate on a large scale, all have experienced who have established bleaching houses on Berthollet's principles. To remedy the great volatility of the acid, potash, lime, and other matters have been used; and hence has proceeded the javelle lie, which is now in common use for domestick purposes. Many English Chymists have proposed a super-oxygenated muriate of lime, to simplify Berthollet's mode of bleaching, of which the latter has given an account in his last edition of his Art of Dying. Many who have bleaching houses on Berthollet's plan, have tried all these methods, but have found nothing that answered their purpose so well as the powder of Tenant and Knox. The discovery of the composition of this powder was made by M. Alyon through the following circumstances.

Before the war, large quantities of the above powder were exported to the continent. A Belgian bleacher, who had a large establishment at Brussels, bought two hundred weight of it; but he had hardly used it before Messrs. Tenant aud Knox informed him, by letter, that the exportation was prohibited, and that therefore they could send him no more. Shortly after, he came to Paris, and brought with him a few ounces of this powder, which remained, and gave it to one of M. Alyon's friends, who interested himself about bleaching concerns also: these gentlemen analysed this powder, and were convinced that it consisted of a mixture of super-oxygenated muriate of soda and of lime. Messrs. Tenant and Knox composed it with one third of muriate of soda and two thirds of lime slacked in water, and dried, which they saturated with oxygenated muriatick acid gas; but M. Alyon's friend was convinced that the lime was in too great a proportion, and he fixed the relative quantities of the composition as follows:

| | |
|---|---|
| Muriate of soda - - - - - - - - - - | 15 pounds. |
| Sulphurick acid diluted with one half water | 10 |
| Oxyd of manganese - - - - - - - - - - | 5 |

This was put altogether into a large matrass of glass, to which was fitted a tube of glass or lead, which was made to descend into a vessel of earthenware or wood, some pebbles were placed about the lower orifice of the tube, to prevent its being closed up, the tube was luted to the matrass, and there was put into the vessel round about the tube, a mixture of three pounds of lime slacked, and well dried, and of eight pounds of sea-salt grossly pounded: the matrass was heated in a sand bath, and when the gas began to be disengaged, the powder was stirred with a wooden spatula, and absorbed the gas as fast as it came over. When no more gas passed, the operation ended, the powder was then put up in a barrel, or in glass bottles. It very strongly attracts the moisture of the air; when an ounce or two of it is put into a large glass of water, it throws out a sufficient quantity of oxygenated muriatick gas, to form a good anti-contagious fumigation; but more gas would be disengaged, if a few drops of acid of vitriol were put into the water which holds the powder in solution. As to domestick purposes it is of great utility. Two ounces of this powder in a pint of common water, with eight drops of vitriolick acid, surpasses in quality a pint of the javelle liquor in its bleaching qualities. The cheapness of its preparation ought to render its use more extensive; those, in France, who do not choose to be at the trouble of making it, M. Alyon adds, may buy it ready prepared at M. Fouques's bleach house in Paris, and that he thinks he has done a publick service in relating the method of making it, as the English keep it a secret.

## OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

The last remark of M. Alyon is not correct. Messrs. Tenant and Knox took a patent for their composition, and of course were obliged to make it publick, by registering the specification in Chancery, and which has been published in the Repertory of Arts, Vol. IX. first series; their patent right was afterwards set aside by a legal decision against them, for an account of which see also Repertory of Arts, Vol. II. new series; and the publick are therefore at liberty to use it freely. Perhaps M. Alyon's method of making it may be more expedient than that mentioned in the specification of the patent, and therefore we insert this paper.

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## DUTCH METHOD OF CURING HERRINGS.

TRANS. SOC. ARTS.

THE busses employed in the fishery carry from 48 to 60 tons, in general, though some are used from that size to 120 tons. The crews of the larger sort consist of 24 men, of the smaller 18.

The nets are cast in the evening, and drawn up in the morning, which last operation takes three hours. From the net the fish are put into baskets.

Twelve of the crew are employed in gutting, salting, and packing; which they can complete for but five last of herrings in a day, though sometimes fifteen last are taken in the same time: at this time the guts and gills are taken out, but the roe or milt is always left with the fish. What are taken during one night, are, before the following sun-set, neatly and skilfully packed in oaken casks, with Spanish or Portuguese bay salt strewed between them.

The Dutch catch their fish regularly and early off Hittland, from the 25th of June to the 16th of July, because they are then fattest; after which the nearer they approach the coast, the leaner and worse they are. During this time all the fresh caught herrings are thrown into casks without pickling, and conveyed to Holland in the jagers or yachts that accompany the herring busses; but, after this period, immediately on being got on board and gutted, they are sorted into three qualities, maiden herrings, full herrings, and shot herrings. The first are those taken earliest, which, though well flavoured, do not keep: full herrings are those taken at Midsummer, on the point of spawning: the brand herrings (so called from the barrels which contain them being marked with a hot iron) are of the same kind as these latter, but so well packed on their arrival, and so close and hard pressed down, that they do not require repacking at other places, but only new pickle; whereas the other sorts, not being so closely laid, must absolutely be re-packed. Shot herrings are those which have spawned, and are consequently thin and lean. With the two last sorts, the busses return to port as soon as they have got their loading, or find no more fish. Here, all, except the brand herrings, are opened, salted anew, repacked, and so pressed that the contents of fourteen casks are repacked in twelve, which makes a last. This repacking, by law, must be performed in publick, where strict watch is kept that the spoiled fish be carefully separated from the good, and the latter thoroughly pressed down and properly laid in the barrels.

The Dutch fishery continues from the 25th of June to the 25th of July on the Scotch and English coasts, off Hittland, Fairhill, and Bocken; and from thence to the 14th of September off Bocken or Serenial; and in the deep water off Yarmouth, and as far as the mouth of the Thames, till the 25th of November, when the regular fishery ceases: but herrings are found off Yarmouth till the end of January, after which the fishery is prohibited, as the spawning season then commences.

There are two methods of salting herrings, called white and red. In the former, the herrings, after being gutted and washed, are either put into baskets, and salt sprinkled in them, both inside and out, and well shaken in the baskets, or else are put in a strong pickle, which is preferable, for twelve or fifteen hours, and are well stirred several times, that the salt may penetrate; they are then taken from the pickle, drained, and packed in barrels, which are strewed at bottom pretty thickly with salt; and if there be time, they are neatly laid in strata, always strewing salt sufficient upon each layer: when the fishery is very abundant, this last operation is deferred till landing, and in the mean time they are only thrown into barrels promiscuously. On landing, they are repacked and sorted, as before mentioned, and regularly coopered, to prevent leaking of the pickle, which spoils the fish. Properly, they should be packed after being one night in pickle. When this cannot be done, the fish do not keep so well, and are reckoned an inferiour sort.

Fish that cannot be packed in two days after being caught, are salted in large heaps, and are called *slabbers*, or coarse goods: they are sent home in the schuyts, washed and smoked, though not so much as the *bicklings*, or red herrings. The salted herrings hitherto spoken of are called *pickled* herrings; those salted and packed in layers, *packed* or *barrelled* herrings; and those half salted and promiscuously packed, are called *wrack* herrings.

For red salting, the fish must be at least twenty-four hours longer in pickle; are then taken out and hung by the head in rows, on wooden poles, in stoves constructed for the purpose, each of which generally contains 12,000 herrings. In those stoves a fire is made under them with vine stalks, or any green faggot wood that affords much smoke and little flame; but no deal or other resinous wood is suffered to be used. Here they remain generally twenty-four hours; and, when they are properly smoked, are packed in barrels, and called *barrelled bicklings*, or red herrings; but if packed in straw, are called *straw bicklings*, which are somewhat less salted than the others.

In Holland, the best fish are chosen for smoking: but in other places the slabbers, or other inferiour herrings, deemed unfit for the usual mode of salting, are only used.

The best red herrings are called, in German, *speck-buckling:* they are cut open along the back. The excellence of the red herrings consists in being large, fat, tender, fresh, properly salted, pliable, soft, of the colour of gold, and not torn or mangled.

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## MODE OF SEPARATING BEER FROM YEAST,

### AND PRESERVING THE YEAST FOR A GREAT LENGTH OF TIME AND IN ANY CLIMATE.

MR. FELTON MATHEW, merchant, London, obtained a patent for the above mentioned object, which may be found in the Repertory of Arts, vol. v. p. 73. Mr. Mathew uses a press, with a lever, the bottom made of stout deal, oak, or any other timber fit for the purpose, raised with strong feet a convenient height from the ground, so as to admit the beer to run off into whatever is prepared to receive it. Into the back of it is let a strong piece of timber, or any other fit material to secure one end of the lever, the top of which is secured by being well wedged up to a girder, or the joists at the top of the building. In this piece of timber is mortised one end of the lever, which is fastened into the mortise with an iron pin or otherwise properly secured; the whole well secured with iron work. The yeast is then put into bags made of sail cloth, or any other strong cloth or material, and carefully tied or secured, then placed flat on the press; a board is then laid on it, and the lever let down on it, and weights are hung at the other end of the lever by hooks or otherwise, and weights are added as the beer runs from the bag, care being taken not to burst the bag nor force the beer out too thick; which to prevent, the bag is placed in a trough of a proper size, with a false bottom, bored full of holes (the sides and ends being likewise bored full of holes) and blocks put above for the lever to act upon. When a sufficient weight has been added so as completely to force the beer out, which may be done by a screw press, if necessary, the yeast, which remains in the bag will crumble to pieces, like flower. It must then be thinly spread upon frames made with thin canvass, hair cloth, or any other thing, which will permit the heat to pass freely through it, in a room, kiln or stove, or other place where a regular heat can be kept up to the temperature of from about eighty to ninety degrees; observing to break it fine as it dries, by passing a board, or other fit thing lightly over it. When completely dry, put it in tight casks, or bottles, so as to exclude the air, or any damp, from it, and it will then keep a great length of time, and in any climate. When wanted for use, it may be dissolved in a small quantity of warm wort, or sugar and water of the temperature of from about eighty to ninety degrees, when it possesses the same quality as fresh liquid yeast.

## SUBSTANCE OF THE SPECIFICATION

### OF A PATENT GRANTED TO MR. RICHARD TILLYER BLUNT; FOR HIS NEW INVENTED COMPOSITION TO BE USED INSTEAD OF YEAST. REPERTORY OF ARTS.

TO make a yeast gallon of the above mentioned composition, containing eight beer quarts, boil in common water eight pounds of potatoes, as for eating;

bruise them perfectly smooth, and mix with them whilst warm, two ounces of honey, or any other sweet substance, and one quart (being the eighth part of a gallon of yeast) of common yeast. And, for making bread, mix three beer pints of the above composition with a bushel of flour, using warm water in making the bread; the water to be warmer in winter, and the composition to be used in a few hours after it is made; and as soon as the sponge (the mixture of the composition with the flour) begins to fall the first time, the bread should be made and put in the oven.

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## SUBSTANCE OF THE SPECIFICATION

### OF A PATENT GRANTED TO MR. JOHN WORTH, OF DISS, IN THE COUNTY OF NORFOLK, ENGLAND, FOR A PREPARATION OR CEMENT FOR PRESERVING SHIPS AND OTHER VESSELS FROM WORMS.

THIS patentee takes of powdered or small pieces of rosin fourteen pounds, sand, sifted and washed clean from dirt or loam, twenty eight pounds, red lead three pounds and a half, oil one pound and three fourths. Melt the rosin over a moderate fire, put the sand and lead in by degrees, then put in the oil; when they are boiling keep them constantly stirring till cold, that you may have a uniform mass. Take of this mass or cement such quantity as may suit your purpose, broken into small pieces, and to every twelve pounds put in a bare half pound of oil. When melted, apply it to what you design, either by pouring it on, or using it with a brush, while boiling hot. It is to be observed that your oil, to be added to the cement, must be of that sort which chymists call fat oil, and that more or less must be used as you want the composition to be harder or softer. This will be of a reddish colour; for the white and green, ceruse and verdigrise may be used.

# OBSERVATIONS

## ON THE RAISING AND DRESSING OF HEMP. BY EDWARD ANTILL, ESQUIRE.

ABRIDGED FROM THE TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

IN raising hemp it is proper to set aside two pieces of ground, of such dimensions each, as it is proposed to cultivate every year, and sow the one while the other is preparing for the succeeding year's crop. The higher and the drier the ground the better, provided it be well manured and made strong and mellow. The ground should not be too sloping lest the good soil be washed away by rains, and it will be an advantage if it slope to the south. Low, rich, warm, and dry grounds will also produce good hemp, but wet land though ever so rich, will not answer the purpose. The ground having previously been made very mellow, some time in May, while in a moist and vegetating state, but by no means wet, must be well ploughed, the furrows made close and even, and the soil must lie light and mellow. It must then be sown, very even, with two bushels of seed upon an acre. A man with an iron toothed harrow should follow the sower, and harrow in the seed with two horses, without balks, as the less the ground is trampled the better. If harrowing one way be not sufficient to cover the seed, though it would be best if that could be done, it must be cross harrowed. The ground being moist, but by no means so wet as to clod, which would ruin the crop, the seed will all start and come up together, which is a sure sign of a good crop, as nothing after that but too much wet will hurt it; for hemp, thus come up, bids defiance to weeds and grass of every kind. Its growth is so quick, and it so effectually shades the ground that nothing below can rise, or show its head; and it so preserves all the moisture below, that the hotter and drier the weather the faster it grows. But if the hemp grows when the ground is dry, that which lies deepest where there is moisture, will come up first, and these plants will shade and starve those which come up after them, by which means the former will be much too large and the latter too small. The crop rightly managed will stand as thick as very good wheat, and be from four to six feet high, and the stems not thicker than good wheat straw. By these means the hemp will be finer, will yield the greater quantity, and may be plucked from the ground, like flax, which will be a great saving. If it be sown thin, that is one bushel to an acre, it grows large, the hemp is coarse and harsh, and it must be cut with hooks, which occasions great waste, for four or five inches above the ground is left as stubble, which contains the best and heaviest part of the hemp.

When the hemp is fit to be plucked, the leaves of the carle, or male hemp, turn yellow and fall off; the sooner then it is plucked the better. It must then be bound in straw bands rather small than large, and each sheaf in two places; and the sooner it is carried to rot the better. Water rotted hemp, if rightly managed is every way better than that which is rotted on the ground; there is less waste in it, it looks brighter and fairer, is esteemed stronger and more durable, and fetches a higher price. Besides it is sooner done and is rotted more evenly and with greater certainty and exactness. Hemp may be rotted in stagnated or standing water, such as ponds, pools, or broad deep ditches, and in such water it is generally four or five days and nights in rotting, and sometimes longer, according to the temperature of the weather. It may be rotted likewise in running water, a brook or river, and in such water, three or four days and nights are sufficient, according to the weather. To know whether the hemp is rotted enough, take a middling handful out of the middle row, and try with both your hands to snap it asunder; if it breaks easy it is rotted enough; but if it appear pretty strong, it must lie longer till it breaks with ease; then it must be taken out and dried as soon as possible. In handling the sheaves take them by the bands, and set them upright against a fence if one be near, or lay them down on the grass, for the water to drain off; then unbind them carefully, open and spread them, that they may dry thoroughly; then bind them again, and house them in a dry tight place.

The reason of handling the hemp in this careful manner is, that when it is well rotted, while it is wet the lint comes off with the slightest touch. Therefore if it be handled roughly, or while wet be thrown into a cart, and carried any distance to be unbound and dried, it will be greatly injured; but when dry it may be handled without suffering any damage.

If the hemp be rotted in running water, the sheaves must be laid across the stream, for if they be laid down lengthways with the stream, the current will wash away the lint, and spoil the hemp; it must be laid down heads and points, two, four, or six thick, according to the depth of the water, and the quantity of hemp. If the bottom be sand, gravel, or mud, three strong stakes must be driven down above and below, and three strong poles must be laid on the hemp and fastened well to the stakes in such manner as to force down the hemp under water, where it is to remain until rotted enough; though if a muddy stream could be avoided it would be best, because it is apt to foul and stain the hemp. If the bottom of the stream be rocky, so that stakes cannot be driven, a rough wall must be made at the lower end of the hemp and along the side to keep it in; and strong poles or rails must be laid on the top of the hemp, and pretty heavy stones upon them, so as to sink the hemp under water, where it must lie till rotted enough.

The hemp intended for seed should be sown on a piece of ground by itself, which must be made very rich and strong. It must be sown in ridges six feet wide; and the seed must be of the largest and best sort, and sown very thin, at the rate of a peck on an acre, or rather six quarts. The thinner it is sown the more it branches, and the more seed it will bear. It should be sown some time about the middle of April, and then the seed will not be ripe till some time after the other hemp is done with. If you have no convenient place to sow your seed hemp by itself, then sow a border of six feet wide, along the north and west sides of your hemp field. The reason for sowing your seed-hemp in such narrow ridges or borders is, that when the carle or male hemp is ripe, and has shed its farina on the fimble or female hemp (by which the seed is impregnated) and the leaves of the carle hemp fall off, and the stem grows yellow, you may step in along the sides, and pull up the carle, without hurting the female, which now begins to branch out, and looks of a deep green colour, and very flourishing: and when the seeds begin to ripen, which is known by their falling out of their sockets, you may all along on both sides, bend down the plants, and shake out the seeds on a cloth laid on the ground; for as they ripen they scatter when shaken by a hard wind, or otherwise. Then it must be watched, and the fowls and yellow birds kept from it, for they are immoderately fond of the seed. As the first ripe seeds are the fullest and best, they are worthy of some pains to save them; and the best way to do that is to bend down the plants all along, on each side of the border or ridge, as is said above, and shake them over a cloth spread on the ground to receive the seed. If one side of the plant be rooted out of the ground, by forcing it down to shake out the seed, there will be no damage, the seeds that remain will ripen notwithstanding: and the plant must be thus shaken every two or three days, till all the seeds are ripe and thus saved. This is much better than pulling up the plants by the roots, and shaking them on a barn floor, and then setting them up against a fence by the side of the barn, for the seed to ripen, shaking them again morning and evening on the barn floor, which is the common practice, for by this method one third of the seed at least never comes to maturity.

In the three bread colonies this writer observes that the spring and summer seasons have of late become very dry; so that a crop of flax is rendered precarious. But hemp does not require half so much rain as flax, and the farmer by raising hemp as above stated, and preparing it in the best manner for spinning and wearing, can with greater certainty supply all his family with good cloth, and the overplus will always find a good market.

The following are the directions of the author for the manufacture of hemp.

If you have a large wide kettle, that will take in your hemp at full length, it will be better; but if your kettle be small, you must double your hemp, but without twisting; only the small ends of every hand must be twisted a little to keep them whole and from entangling. Then first of all place some smooth sticks at the bottom of the kettle, so as to lie across each other, three or four layers, according to the size and depth of your kettle, to keep the hemp from touching the liquor. Then pour some lie, half as strong as what you make soap of, gently into the kettle, not so much as to rise to the top of the sticks, they being kept down to the bottom. Then lay in the hemp, each layer crossing the other, so that the steam may rise up through the whole body of the hemp, and cover your kettle as close as possible, and hang it over a very gentle fire and keep it simmering or stewing, but not boiling, so as to raise a good steam for six or eight hours. Then take it off, and let it stand till it is cool enough to handle. Take out the hemp, and wring it very carefully as dry as you can, and hang it out of the way of the wind in your garret or barn, shutting the doors. There let it remain, turning it now and then till perfectly dry. Then pack it in some close dry place till you wish to use it, but take care to visit it now and then, lest some part of it should be damp and rot. Wind and air weaken and rot hemp and flax very much. Then, at your leisure, twist up some of the hands, as hard as you can, and with a round smooth hard beetle, on a smooth stone, beat each hand by itself, turning it round from side to side till every part be well bruised. You must then untwist it and hatchel it, first through a coarse, and then through a fine hatchel: and remember that hatcheling must be performed in the same manner that a man would comb a fine head of hair; he begins at the end below, and, as that disentangles, he rises higher, till at last he reaches up to the crown of the head. The first tow makes good ropes for the use of the plantation; the second, good coarse shirting; and the hemp itself excellent linen. The same method of steaming softens flax very much.

## REMARKS BY T. G. F.

The foregoing article cannot but prove highly interesting to those who are engaged in agricultural pursuits. The disagreeable and unwholesome process, however, of water rotting hemp, it is hoped may be avoided by the method described by M. Bralle, page 27.

Hemp or flax, may be steamed by a process similar to that which is stated in my remarks on that article, and according to principles laid down by count Rumford, page 58. A small boiler, and even a common tea kettle, would thus answer the purpose of supplying steam for marcerating large quantities of hemp or flax, without the possibility of scorching the materials subjected to the operation of the steam, and the vessels which contain the flax or hemp may be wooden tubs or vats, instead of metal.

# ON THE FORM OF ANIMALS.

BY HENRY CLINE, ESQ. SURGEON. COM. BOARD OF AGRICULTURE, 1805.

IT is the intention of this communication to ascertain in what instances crossing the breed of cattle is proper, and in what prejudicial; and the principles upon which the propriety of it depends.

It has been generally understood that the breed of animals is improved by crossing with the largest males. This opinion has done much mischief, and would have done more if it had not been counteracted by the desire of selecting animals of the best forms and proportions, which are rarely to be met with in those of the largest size. Experience has proved that crossing has only succeeded in an eminent degree in those instances in which the females were larger than in the usual proportion of the females to the males; and that it has generally failed when the males were disproportionally large.

The external form of domestick animals has been much studied, and the proportions are well ascertained. But the external form is an indication of internal structure. The principles of improving it must therefore be founded on a knowledge of the structure and use of the internal parts.

Of these the lungs are of the first importance. It is on their size and soundness that the strength and health of an animal principally depends. The power of converting food into nourishment is in proportion to their size. *An animal with large lungs is capable of converting a given quantity of food into more nourishment than one with smaller lungs; and therefore has a greater aptitude to fatten.*

CHEST.

The size and form of the chest indicate the size of the lungs, of which the form should approach to the figure of a cone having the apex situated between the shoulders and its base towards the loins: a circular form of chest is preferable to one deep and narrow, for though the latter may have greater girth, the former will have greater internal space in proportion.

### THE PELVIS.

The Pelvis is the cavity formed by the junction of the hip bones with the rump bone. This cavity should be large in a female, that she may be enabled to bring forth her young with less difficulty; when this cavity is small, the life of the mother and her offspring is endangered.

The size of the pelvis is indicated by the width of the hips, and the space between the thighs; the breadth of the loins is always in proportion to that of the chest and pelvis.

### HEAD.

The head should be small, by which the birth is facilitated to the offspring; it also indicates the animal to be of a good breed, and occasions less weight of unprofitable substance to the consumer.

Horns are useless to domestick animals, and occasion a great weight of bone in the head The skull of a ram with horns weighed five times as much as that of one without horns, each being four years old. A mode of breeding which would prevent the production of horns, would therefore afford a considerable saving.

The length of the neck should be proportioned to the height of the animal, that it may collect its food with ease.

### MUSCLES.

The muscles and tendons, which are their appendages, should be large, by which an animal is enabled to travel with greater facility.

### BONES.

The strength of an animal does not depend on the size of the bones, but on that of the muscles; many animals with large bones are weak, their muscles being small.

Animals imperfectly nourished during growth have their bones disproportionally large. If this originated from a constitutional defect, they remain weak during life; large bones may therefore indicate an imperfection in the organs of nutrition.

### OF THE IMPROVEMENT OF FORM.

The chief point to be attended to for the improvement of form, from Mr. Cline's principles, is the selection of males for breed of a proportionally smaller size than the females, both being of approved forms; the size of the fœtus depends on the size of the male, and therefore when the female is disproportionally small, her offspring has all the disproportion of a starveling, from want of due nourishment.

The larger female has also a greater supply of milk, and her offspring is therefore more abundantly provided with nourishment after birth.

When the female is large in proportion to the male, the lungs of the offspring will also be greater; by crossing in this manner, there are produced animals with remarkably large chests, as has been often noticed: the advantage of large lungs has been already pointed out.

In animals where activity is required, this practice should not be extended so far as in those which are intended for the food of man.

The size of animals is commonly adapted to the soil which they inhabit; when the produce is scanty, the breed is small: the large sheep of Lincolnshire would starve, where the small sheep of Wales find abundant food.

Crossing may be attended with bad effects, even when begun on good principles, if the above rule be not attended to throughout; for instance, if large ewes were brought to Wales, and sent to the rams of the country, the offspring would be of improved form; and, if sufficiently fed, of larger size than the native animals but the males of this breed would be disproportionately large to the native ewes, and therefore would produce a starveling ill formed race with them.

The general mistake in crossing has arisen from an attempt to increase the size of a native race of animals; being a fruitless effort to counteract the laws of nature; which, from theory, from practice, and extensive observation, Mr. Cline concludes to be decidedly wrong; for in proportion to this unnatural increase of size, they become worse in form, less hardy, and more liable to disease.

## OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

In this very excellent communication of Mr. Cline's, which is fraught with valuable information, there is one position which can be only understood in a general sense, namely; that females of the largest size give most milk in proportion: small cows are often known to give more milk than large; the quantity of milk seems to depend on the particular breed, and on the supply of food.

Fatness also does not seem to be inconsistent with every disease of the lungs, though no doubt it is with most, at least if we may argue from the human race to brute animals, as nothing is more common than for fat people to be asthmatick.

The directions for breeding given by Mr. Cline, are certainly the best calculated to produce fine healthy animals, and of course the most wholesome meat; but there is some doubt whether this would be so agreeable to the breeders, as the exuberant fatness, which has been so fashionable among them for some years past, and which in all probability is inconsistent with the health of the animal: a prodigious fatness is justly considered as a state of disease in mankind, and there is no reason why it should not be so in beasts also: as a confirmation of the opinion that the excess of fat does not improve the quality of the meat, it is pretty generally acknowledged that the average of mutton in the London markets affords a much more coarse and unpalatable food than what was in general to be had some years back, before the prodigiously fat breeds became so prevalent. There is great reason to believe that the fine flavour of the meat may not solely proceed from an adequate age of the animal, but may also depend on particularity of breed, as much as great fatness or quality of wool; and if the breeders of sheep would attend a little to this circumstance in future, they would confer a singular favour on all those who eat mutton, who are at least as numerous as the tallow chandlers and clothiers, whose interests they have hitherto chiefly studied in this matter, next to their own.

## ACCOUNT

### OF MR. DAVY'S PAPER ON THE ANALYSIS OF SOILS, COMMUNICATED TO THE BOARD OF AGRICULTURE, 1805.

MR. DAVY having first mentioned that the advantages of analysis of soils have already been felt by some eminent cultivators since they were pointed out by Lord Dundonald and Mr. Kirwan, and that Mr. Young has furnished many useful facts and observations with regard to them, proceeds to state the various substances which usually compose the soils of this country; namely, silex, alumine, lime, magnesia, matter from animal decomposition, matter from vegetable decomposition, salts, and oxyds.

The instruments and chymical re-agents proper for making analysis of soils, may be had, ready packed in cases, at Mr. Knight's, Foster-lane, Cheapside.

Mr. Davy recommends that when the soil of any estate is examined, a variety of specimens should be taken from different parts, whenever there is the least reason to suppose that any difference of soil exists, for sometimes one part of a field is silicious, and another calcareous. Each specimen should consist of between 200 and 400 grains, should be taken up from two to three inches beneath the surface, at a dry season and be exposed to the atmosphere till dry to the touch, and preserved in bottles with ground stoppers till the analysis is made.

The specifick gravity of each specimen should be examined first; this may be done by filling a small bottle with water, weighing it, pouring out one half, and putting in the soil in its place till the bottle is again full, then weighing it a second time and noting the difference; thus if the bottle of water weighs 400 grains, and when the soil is added, as described, weighs 600 grains, the specifick gravity of the soil will be two; that is, it will be twice as heavy as water; and if the mixture weighed 565 grains, the specifick gravity would be 1825, water being 1000.

1. To ascertain the absorbency of the soil, it should be heated in a vessel at 300 degrees Fahrenheit, or till wood held in contact with the vessel begins to be charred: if after twelve minutes the loss of weight should be 50 out of 400 grains, the soil may be considered as highly absorbent.

2. The next process should be to separate with a sieve, the stones, gravel, roots, and vegetable fibres, none of which should be removed before the former operation, as they are often themselves highly absorbent.

The weight of these matters should be noted, and the quality of the stones or gravel examined; if they are calcareous, they will effervesce with acids; if silicious, they will scratch glass; if of the common aluminous class of stones, they will be soft, easily scratched with a knife, and will not effervesce with acids.

3. The sand should next be separated by agitation in water, it will first subside, and the other matters

will remain for two or three minutes suspended in the water, which should then be poured off, filtered, dried, and weighed, the sand should be weighed also, and the lixivial water examined as to its containing salts, and animal or vegetable soluble matters, in solution.

4. The sand may be examined by gradually pouring muriatick acid on it (if any effervescence ensues at first) till the acid ceases to be neutralized, or loses its sour taste; this process will dissolve all the calcareous part of the sand, and the remainder will be silicious, which should be washed, dried, and heated strongly in a crucible; the difference between its weight and that of the whole sand, indicates the proportion of calcareous sand.

5. The finely divided matter, separated in the third process, consists sometimes of all the four primitive earths, with animal and vegetable matter; to ascertain the nature of this matter, muriatick acid in equal weight, with twice its weight of water added, should be poured on it, often stirred, and suffered to remain at rest for an hour and a half: this will dissolve the carbonate of lime, magnesia, and oxyd of iron, contained; the fluid should be separated by a filter, and the solid matter washed, dried, and weighed, its loss will denote the quantity of solid matter dissolved; a little prussiate of potash added to the solution will show by a blue precipitate the presence of oxyd of iron if any exists. To the remaining fluid, carbonate of potash should be added till all effervescence ceases, and the taste indicates an excess of alkali. The precipitate thrown down by this process will be carbonate of lime.

The remaining fluid being boiled after this, will deposit the magnesia contained, combined with carbonick acid.

6. After the fine matter of the soil has been acted on by muriatick acid, the quantity of insoluble animal and vegetable matter may be ascertained, by heating it to strong ignition in a crucible till no black remains in the mass, which should be often stirred with a metallick wire during the process; a smell from the roasted matter resembling that of burned feathers, indicates animal matter; and a copious blue flame arising denotes a considerable proportion of vegetable matter. When speed is required, the process may be hastened by adding nitrate of ammonia by degrees in the proportion of one-fifth of the resident soil.

7. The next process is to ascertain the alumine, silex, and oxyd of iron contained; for this purpose, the matter, after undergoing the former operations, should be boiled for two or three hours in sulphurick acid, diluted with four times its weight of water, the acid should be one-fifth the weight of the soil.

The insoluble substance remaining may be considered as silicious, and its quantity may be known by drying and weighing it.

If the fluid contains alumine and oxyd of iron in solution, carbonate of ammonia added in excess throws down the alumine, and leaves the oxyd of iron, which may also be separated by boiling.

8. Saline and soluble animal or vegetable matter, is known by examining the water of lixiviation used for separating the sand. This should be evaporated to dryness at a heat below that of boiling water. If the solid matter obtained be of a brown colour, it may be considered vegetable extract; if its smell be strong and fœtid, it contains animal matter; if it be white and transparent, it is principally saline matter; if this saline matter scintillate on burning coals, it shows it to be nitrate of lime, potash, or ammonia. Sulphate of magnesia is detected by its bitter taste, and sulphate of potash by its producing no alteration in solution of carbonate of ammonia, and precipitating muriate of barytes.

9. When sulphate of lime is supposed to be contained in the soil, a given weight of it (as 400 grains) must be heated red for half an hour in a crucible, mixed with a third of powdered charcoal; the mixture must be boiled for a quarter of an hour in half a pint of water, then filtered, and the fluid exposed for some days to the air in an open vessel. If any soluble quantity of sulphate of lime existed in the soil, a white precipitate will gradually form in the fluid, the weight of which will indicate the proportion.

After this the remaining soil may be examined for phosphate of lime by digesting muriatick acid on it, evaporating the solution, and washing the solid matter, which will leave the phosphate of lime.

## CHYMICAL COMPOSITION OF FERTILE SOILS.

Fertile soils always consist of certain proportions of aluminous and calcareous earths in a finely divided state, and of vegetable or animal matter.

The quantity of calcareous earth is very various, and in some cases very small; a very fertile corn soil from east Lothian afforded eleven parts in a hundred of calcareous earth, and twenty five of silicious sand, it however afforded some indications of a small quantity of phosphate of lime, by which its fertility might be in some degree caused, as this substance is found in wheat, oats, and barley. It also contained nine parts of animal and vegetable matter. An equally productive soil from Somersetshire, on the contrary, contained eight ninths of calcareous earth to one ninth of silicious sand, held about five parts in the hundred of vegetable and animal matter, and had no phosphate of lime.

In general bulbous roots require a more sandy soil than grasses, and less attractive of moisture; plants and trees whose roots are hard and fibrous, will thrive best in a soil moderately dry, which does not contain too much vegetable matter.

## IMPROVEMENT OF SOIL.

A soil deficient in fertility should be compared with a fertile soil in its neighbourhood in a similar situation, the analysis of both will show what is wanting in the inferiour soil. Thus if the fertile soil contain a larger proportion of sand, calcareous earth, or clay, &c. the process of amelioration for the other soil would consist in adding to it the same substance. In adding lime, magnesian limestone should be avoided, having been found to be injurious to land in several instances (vid. Phil. Trans. for 1799.) Magnesian limestone is known by its greater hardness, by the greater length of time it requires for solution in acids, and by analysis.

Improvements made on soils by rendering them of the best composition as to their earthy parts, establishes a permanent fertility, and renders them capable of attracting a large portion of vegetable nourishment from the atmosphere, and thereby of yielding crops with comparatively less labour; whereas by applying animal or vegetable manure the benefit is only temporary, and in all cases exhausted by a certain number of crops.

# OBSERVATIONS.

BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

Those who are moderately acquainted with chymical matters will certainly find the directions given by Mr. Davy, for analysis of soils, extremely valuable. (These are contained more fully in the Repertory of Arts, Nos. 38 and 39.) But those who have never performed any chymical operations would do well, before they attempt to examine soils in this manner, to get some previous instructions in general chymistry, and learn particularly the effect of the chymical re-agents: for which latter purpose they will find the small volume published by professor Gottling on chymical tests, particularly serviceable. Farmers, in general, however, would find it more advantageous to employ some chymical gentleman to make the analysis for them of their soils, than to spend their time in learning a new science, whose operations require the utmost delicacy and address in most cases, and in none more than in analysis. If no chymist live near them, specimens of the soils collected as here directed, packed in bottles with ground stoppers, and properly numbered, might be forwarded for examination at a moderate expense to a considerable distance. It would be an object worthy the attention of the Board of Agriculture to facilitate the investigation of soils in this manner, by making it worth the while of some experienced chymist to analyse soils for farmers on moderate terms, and publickly advertise to receive specimens from all parts of the kingdom for this purpose.

# ACCOUNT OF THE DOUBLE BOATS

BUILT BY THE DIRECTION OF SIR SYDNEY SMITH, OF BUILDING VESSELS OF THIS KIND ON A LARGE SCALE, AND OF OTHER VESSELS FORMERLY BUILT ON THE SAME PLAN. BY MR. J. W. BOSWELL. REP. OF ARTS, NO. 41, NEW SERIES.

AS these boats have excited much curiosity, a brief account of them may not be unacceptable.

The first double boat built by Sir Sydney Smith consists of two of the common Thames wherries, united by a stage or platform laid over them, of about twenty feet breadth. The wherries were raised one streak to receive this stage, which is formed by pieces of scantling, about six inches by three, laid across the boats, and firmly secured to them, upon which a deck is afterwards laid down. Beyond this stage the boats project about five feet at either end; these parts being also decked over, and the whole water-tight above. Long, narrow hatchways open into each wherry: their heads and sterns are connected by cross pieces, and each is furnished with two masts; so that the double boats carry four masts in all, on which sprit-sails are used, for more conveniently reversing the direction of the vessel without putting about, either end being so formed as to go foremost with equal facility.

Two other vessels have since been built on this plan, upon a larger scale: they are called the Gemini and the Cancer. The stages or platforms of these boats are not so broad in proportion as that of the first. The Gemini has also her two supporting boats formed with the internal side of each, perpendicular and straight, so that each resembles half of a boat, divided lengthwise vertically. The sheer of the latter boats is also much greater than that of the first, their extremities being considerably higher than their decks.

The Gemini has four masts; the Cancer is said to have but two. Each double boat is furnished with a small gun, placed on the middle of the platform, and is fitted with a suitable number of oars, to be used in calm weather.

The chief advantages of double-hulled vessels are stated to be,—the great velocity with which they may be made to sail,—their considerable resistance to the making of lee-way,—the facility of manœuvring,—their great steadiness, by reason of which they can, if used in war, direct their guns with more effect than other vessels of equal burthen,—their taking the ground well, and being steady and secure where other vessels would be overset,—and the great relative size of their decks, which gives more room for working guns, and managing the sails.

Mr. Boswell, the ingenious author of this paper, has added historical and practical remarks on this kind of vessels. He justly observes, that such vessels of a large size should not depend on a single series of beams, but at least two series, one over the other, with an intermediate space of not less than five feet. The lower series of beams should be planked outside, the same as the rest of the vessel, which thus forming the bottom of a third vessel in the midst of the other two, should slope gradually upwards at either end, that it might make less resistance to the waves, and tend to surmount them when it encounters them. This middle vessel, instead of being entirely sustained by the other two, might be so constructed as to draw a foot or two of water; a construction from which several advantages would result.

Double vessels of a large size should not be made to go with either end foremost; for besides the impossibility of staying their masts properly for this purpose, they could not thus be shaped to the greatest advantage for swift sailing; for the head requiring a certain fulness to bear up against the impulse of the sails, and the stern a certain length of slope, the head also requiring the rounding off to be sidewise, and the stern requiring the sloping to be mostly from the bottom upwards, the shape which would suit the one would not the other, and an intermediate shape would be imperfect for both.

Small double vessels may have the platform strengthened by two or more pairs of shears erected across it, each well secured to the deck by a perpendicular shroud descending to it from the upper angle, or by a mast rising in that part, well bolted to the platform below, and firmly fastened to the shears above: probably the shears in the first of Sir Sydney's boats might have been for this purpose.

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# ACCOUNT

## OF THE PROFIT AND LOSS UPON A FLOCK OF SHEEP WINTERED AT CLERMONT, IN 1806—7.

COMMUNICATED TO THE AGRICULTURAL SOCIETY OF DUTCHESS COUNTY NEW-YORK. BY ROBERT R. LIVINGSTON.

THE flock consisted of six full bred Merino sheep, twenty-four three-fourths bred, thirty half bred, and seventeen common sheep of good quality. They were kept in one flock and treated alike in every respect. The full bred were two rams and four ewes, one of the ewes died in February a lambing—She was eight years old. Two ewes lambed in March, the other was a yearling, and had not taken the ram. On the twenty-eighth of May the five sheep were shorn, and gave 28 3-4 pounds of wool. They had not been washed, but as they were well littered in the fold, and kept out except at night, the wool was not so foul as common.

| | | | | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|
| 28 3-4lbs. of wool sold to Mr. Booth, at 10s. | | | | 14 | 7 | 6 |
| 1 ram lamb sold at $100 | | | | 40 | 00 | 0 |
| 1 ewe do. not sold, as I have not yet my complement, | | | | 40 | 00 | 0 |
| Wool from the ewe that died 4 1-2 at 10s. | | | | 2 | 5 | 0 |
| | | | | 96 | 12 | 6 |
| Deduct for the old ewe that died which cost at 2 years old $80 | 15 | 00 | 0 | 18 | 12 | 0 |
| Keeping 6 sheep at 12s. | 3 | 12 | 0 | | | |
| | | | | *l.* 74 | 00 | 6 |

ACCOUNT OF 24 THREE QUARTER BRED SHEEP.

| | | | |
|---|---|---|---|
| 24 sheep, among which there was but one yearling wether, gave 106 lbs. of wool, sold at 5s. | *l.* 26 | 10 | 0 |
| Keeping at 12s. Deduct | 14 | 8 | 0 |
| Clear profit on the wool, | 12 | 2 | 0 |
| Remains to be credited 21 seven-eighths bred lambs at | *l.* | | |

N. B. This wool was worth at least eight shillings, though sold at five shillings, the rate at which the half blood sold. Though it was much finer and many fleeces very little inferiour to the full bred sheep.

ACCOUNT OF 35 HALF BRED MERINOS.

| | | | |
|---|---|---|---|
| 5 lambs sold before shearing to Mr. Dean at $ 12. | *l.* 24 | 00 | 0 |
| 30 shorn gave 139 1-2 lbs. of wool, sold at 5s. | 34 | 17 | 6 |
| | 58 | 17 | 6 |
| Expense of 35 at 12s. | 21 | 00 | 0 |
| Clear profit exclusive of lambs, | 37 | 17 | 6 |
| To twenty-two quarter bred lambs, | | | |

N. B. I have not carried out the price of the lambs, because this is in some measure arbitrary and proportioned to the demand. I have myself however purchased three quarter bred ewes at seventeen dollars and sold my half bloods at twelve dollars. I value the seven eighths at forty dollars the ewes, and fifty for the rams. Taking the average at fifteen dollars, for the whole twenty two lambs, it would amount to four hundred and forty pounds, to be added to the account of profits.

### RECAPITULATION.

| | | | |
|---|---|---|---|
| Clear profits on five Merinos, | l. 78 | 00 | 6 |
| Do. on the wool of 24 three quarter bred do. | 26 | 50 | 0 |
| Do. on 35 half bred do. including 5 sold, | 37 | 7 | 6 |
| Clear profit on 64 sheep, exclusive of lambs, | 141 | 18 | 0 |

### ACCOUNT OF SEVENTEEN COMMON SHEEP, PART OF THE ABOVE FLOCK.

| | | | | | | |
|---|---|---|---|---|---|---|
| Keeping at 12s. of seventeen sheep, | | | | l. 10 | 4 | 0 |
| Fleeces unwashed 62 1-2 lbs. at 2s. 6, | | | | 8 | 11 | 3 |
| Loss, if lambs are not credited, | | | | 1 | 12 | 9 |
| Fifteen lambs at 12s. | l. 9 | 00 | 0 | | | |

Two things will require explanation in the above statement. First, the quantity of wool given by my Merinos, and next the low price at which I sold the wool of the three quarter bred sheep.

It will seem extraordinary that five merinoes should have given twenty-eight pounds and three quarters of wool, which is near six pounds, and would probably amount to about four pounds of washed wool per head. But it is to be considered that these were chosen, or bred from those that were chosen with care out of a flock of two hundred that were themselves an improved stock. For it is an undoubted truth that the Merinos of the national flock have greatly improved in France by care and attention ; that they are larger and yield more wool (without the latter having deteriorated) than the Merinos of Spain. This is a very encouraging circumstance, and the rather as I can add from my own experience, that the French Merinos improve here when well well kept. That there is no errour in my statement is clear from this circumstance. Mr. Booth purchased the wool and weighed it a second time himself, after it had been weighed by my own overseer, their accounts agreeing exactly.

Though the wool of the fourth bred sheep was only sold at five shillings, yet it was worth at least eight, since it was in most of the fleeces, nearly as fine as that of the full bred sheep. But as this was the first time I had sold the wool, and Mr. Booth took all I had, I gave it to him at the price that he had put upon that of the half blood sheep. I should mention here, that Mr. Dean informs me, that the five lambs he had of me, have given him five pounds of washed wool per head, which he can sell to the hatters at eight shillings per pound, so that had they been purchased only for the wool, they would have yielded about thirty per cent on the capital.

Though in the above statement I have credited the wool below its real value, and at the price at which I sold it, yet even at these prices, the contrast between the Merino and the common sheep is sufficiently obvious to induce every intelligent farmer to change his stock as fast as he can do it with convenience, and without too much expense. Without speaking of the full blood, which it would be difficult as yet to procure, I will contrast the half bloods with the common sheep kept with them, and fed exactly alike. My half bloods gave in wool eleven shillings and ten pence per head profit, after paying twelve shillings for their keeping; whereas the keeping of the common sheep amount to a fraction more than one shilling and ten pence per head beyond the value of their wool, making a difference of thirteen shillings and three pence per head, between the profit of half bred Merinos and common sheep, supposing the lambs both equal in value, though in fact, the difference in the value of the sheep must necessarily extend to the lambs, and render the contrast still more striking. Let any agriculturalist make the calculation upon a flock of one hundred wethers of each sort, and conviction must stare him in the face. One hundred common wethers would give if well kept, 250 pounds of washed wool, worth three shillings per pound, fifty-two pounds ten shillings. The same number of half-bred Merinos would yield at least 400 pounds, worth eight shillings, or one hundred and sixty pound. Deduct the keeping at twelve shillings, and the merino flock affords a clear profit of one hundred pounds, while the loss upon the common sheep amounts to seven pounds ten shillings. They are then a losing stock till sold to the butchers, and then if killed at three years old, do not give seven shillings a year profit per head. Thus if sold fat they are worth three hundred pounds; from this must be deducted the annual loss for three years 22l. 13s. leaving an ultimate clear profit of $ 243 25, at the end of three years, during which the time the owner has been paying an annual loss with the interest of which the flock should be charged. While on the other hand the half blood Merinos will obtain the same price from the butcher at the end of three years, and will in the mean time have paid an annual profit of 100l. yearly for the interest of which the flock should be credited, and if sold in the winter when their fleeces are grown, will give an additional profit of 200 dollars, beyond the common sheep sold under similar circumstances. Who is there that does not feel the difference between receiving 100l. yearly, and waiting three years before your capital produces any thing? It may be said the Merinos are less profitable from want of size, as animals of the same species, generally speaking, eat in proportion to their size. I think there is no weight in this objection if it was really founded. But this I can say, that I have no doubt that if my sheep of the full and mixed breed were weighed against any common flock of equal numbers, they would outweigh them. They are certainly heavier and better woolled than any other sheep that I have seen, except some of the best English breeds. We should add, the merino will yield a greater profit if kept seven years, whereas, every year that a common sheep is kept after he is fit for the butcher is so much loss, inasmuch as the wool does not pay for his keeping.

These observations, founded upon undeniable facts, are so striking, that I hope to see this useful breed of sheep as much encouraged as it deserves to be, and I deem it a very happy circumstance, that the introduction of them by colonel Humphreys into Connecticut from Spain, and by myself from France in the same year, into this state, furnish the intelligent farmer with means for the gradual change of his flock, which may be effected by the purchase of three quarter and half blooded rams, whose fleeces alone will annually pay thirty per cent upon the price they cost, so that in fact, the change may be wrought without any expense, and for a trifling advance of money. I am satisfied that even the introduction of one quarter Spanish blood into a flock will improve the fleece to the value of five shillings, so that instead of losing annually one shilling and ten pence on the wool of every sheep in the flock, three shillings and two pence will be gained; and a ram who will cost about three pounds more than a good common ram, will add twelve pounds ten shillings yearly to the value of a flock consisting of fifty ewes.

ROBERT R. LIVINGSTON.

Clermont, July 2, 1807.

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## ON THE USE OF LIME

### MIXED WITH GUNPOWDER, IN RENDING ROCKS AND STONES. BY H. D. GRIFFITH, ESQUIRE, OF CAERHUN, NEAR CONWAY, NORTH WALES.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY,

HAVING been for some time in the habit of perusing your interesting papers on agriculture and other subjects, I am induced to lay before the society a circumstance, which, though perhaps familiarly known to them, might, if more generally divulged through the channel of their publications, be of infinite advantage to the publick.

In clearing my lands of the heaps of stones with which this country every where abounds, I found the quantity of gunpowder used in the operation, to amount to a considerable sum at the end of the year; and, as the price of this article has been increasing of late to an enormous amount, I had recourse to an expedient, by which the expense of it has been materially diminished.

I weighed out two pounds of gunpowder, and one pound of quick lime, well dried and pulverized; which, after having been thoroughly mixed with each other, I delivered to the blaster, with directions to apply it, in similar quantities as he would have done the gunpowder by itself. I then selected six of the hardest granites I could find for the experiment; and the effects of the explosion were precisely the same as if gunpowder alone had been used. It now occurred to me, that this might be fallacious, and that a smaller proportion of gunpowder would produce the same effect as a larger; I accordingly ordered the man to bore holes in a similar number of stones, of the same texture and size with the former, and to put in a less quantity of gunpowder, by one-third, than he would have done if it had been left to his own management. The stones were separated by the shock; but the difference in the effect was manifest to every person in the field; those with the mixture of lime and gunpowder having been much more effectually broken and shattered than the others.

After the success of this experiment, I have constantly adhered to the practice; and am so satisfied of its utility, that I wish to see it more generally adopted. One thing is certain, that a mixture composed of equal parts of quick-lime and gunpowder will *explode;* and, if this mixture were used merely as a train of communication to the powder within the stone, what a national saving would it be in works carried on upon an extensive scale, such as the numerous quarries and mine works of this kingdom!

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## ON THE CULTIVATION OF POTATOES

FROM THE RIND, &C. BY THE REV. EDWARD WHITTLE, OF ODSTOCK, NEAR SALISBURY.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY.

PERHAPS, amongst all the various kinds of information, there may be times and seasons when that which is the most simple may be of the most general use, because it can be more easily and more effectually communicated, and carried into practice with greater facility.

Notwithstanding the considerate goodness of the Society, in informing the publick of the cheapest method of raising potatoes, and recommending them at this time to plant more than usual, the growers of that useful root are, in general, so bigotted to their old method of doing things, that it is with the greatest difficulty they can be prevailed on to make improvements, although they would certainly tend to their own and the general good; and are rendered quite certain by experiments already tried. It is in consequence of conversation with men of this description, that I am induced to trouble you with this letter; men who would not be convinced to the contrary, but that the decaying potatoe afforded so much more nourishment to the green which sprung from it, than could possibly be afforded from a piece of rind, as would render the crop much more abundant; and affected to disbelieve what was inserted in the Salisbury Journal by your Society, because the persons' names who made the experiments were not inserted. However, having been in the habit of planting potatoes for these fifteen or sixteen years past, I have been induced to make the following experiments.

In the year 1790, I planted a large square of potatoes, one-third of which was with *the rind;* one-third with *whole potatoes;* and the other part with *pieces*, cut in the usual way; and I assure you, when the season came for digging, there was not the least visible difference in the produce.

The following year, I planted in the same row or drill, one whole potatoe, one piece, and one piece of rind, in which there was an eye, alternately; and, when the season came for digging, I was very careful in my observation, but unable to perceive any difference in the crop.

In the year 1793, when the servant was digging up my potatoes, besides those fit for eating, I discovered a great number about the size of a walnut, and from that to a hazel nut, which I ordered to be left in the ground. In the spring of 1794, my two potatoe beds were irregularly covered with greens, which spring from these small potatoes; I therefore prepared, about the middle of April, (for, on account of the coldness of the land, I have always had the best crops from potatoes planted at that time) two other beds, about the same size, into which I transplanted these greens; about one-third of which had the seed hanging to them, and about two-thirds had not, having dropped off in drawing. With these I planted one bed and a half, and made up the other half bed partly with whole, and partly with potatoes cut in the common way, some in drills, and some planted in holes made with a setting-stick; and I have to state, that we were as exact as possible (without weighing or measuring) in our observations, and we could not discern the least difference in the production, the crop being, to all appearance, quite as good from the shoots as from the whole or the cut potatoe; and I am convinced there is not the least necessity for planting the potatoe, in order to raise a crop, as the rind, or shoots, will produce one equally as good. The reason which induced me to make out the remaining half bed with whole and cut potatoes, when I before was satisfied that the rind would answer the end, was, that if I had told my neighbours that the shoots produced as good a crop as the rind, and the rind as the shoots, they would have replied, "that is very probable, but if you had planted whole, or cut potatoes, your crop would have exceeded either!"

In a second letter, Mr. Whittle writes as follows:

I have only to observe, that I continue, as usual, to plant only the *parings* of potatoes, and the young shoots which occasionally spring from the very small ones, generally left in the ground as good for nothing, and which are seldom picked out, except for the purpose of cleaning the land. Sometimes I have planted them in drills, and sometimes in holes made with a stick, covering them with muck; but, as to the manner of planting, I have never observed any difference in the crops. Last year, indeed, I was from home a considerable part of the year, and I find the potatoes were cut in pieces when planted; but I have found no advantage by it in the present crop, except what I expected from new ground.

When the potatoes are pared for planting, one or two eyes should be carefully preserved in every piece, and a small portion of the potatoes, about the size of a horse bean, to every eye.

# ACCOUNT OF A METHOD

## OF DESTROYING CATERPILLARS ON GOOSEBERRY BUSHES.

### FROM THE PRIZE ESSAYS OF THE HIGHLAND SOCIETY OF SCOTLAND.

A RECEIPT for this purpose was offered to be communicated to the society, by William Henderson, at Baldridge Burn, near Dumfermline, on the 6th of February, 1795, for a suitable reward. The proposal was referred to a sub committee, of which Dr. Monro, professor of anatomy in the University of Edinburgh, was chairman; who, after making trial of the receipt, gave in their report on the 1st of July, 1796. The receipt for the preparation, and the manner of using it, was in the following words.

Take one Scots pint of tobacco liquor, which the manufacturers of tobacco generally sell for destroying bugs, and mix therewith about one ounce of alum; when the alum is sufficiently dissolved, put this mixture into a plate, or other vessel wide and long enough to admit of a brush, like a weaver's brush, being dipped into it; and, as early in the season as you can perceive the leaves of the bushes to be in the least eaten, or the eggs upon the leaves (which generally happens about the end of May, and which will be found in great numbers on the veins of the leaves on their under side) you are to take the preparation or liquor, and dip the brush into it, holding the brush towards the under side of the bush, which is to be raised and supported by the hands of another person; then, by drawing your hand gently over the hairs of the brush, the above liquid is sprinkled, and thrown in small drops on the leaves: the consequence of which is, if the eggs are there, they never come forward; and if they have already generated worms, in a minute or two after the liquor touches them, they either die, or sicken so as to fall off the bush, at least they do so upon giving it a little shake. If, upon their thus falling off, they shall not appear to be completely dead, the bush should be held up, and either a little boiling water from a watering pan thrown on them, or a bruise given them by a spade or shovel, or the earth where they lie turned over with a hoe. This preparation does not in the least injure the bushes.

The liquor here meant is generally not in the same state it is extracted from the tobacco, but is mixed, by the tobacco manufacturers, with cold water, in the proportion of four or five pints of water to one of the original juice or essence. Therefore, any person who may purchase the juice itself, unmixed, must mix it with water in the above proportion; and the quantity of alum must be about an ounce for each Scots pint of the mixture.

Dr. Monro's report was in the following words: "I observed along with Mr. Hamilton and Mr. Gordon (two other gentlemen of the committee) and two gardeners who were present, that such caterpillars as were wetted by the liquor Mr. Henderson employs, were killed in a very few minutes; and the experiment has been repeated by my own gardener, with the same effect. I have likewise found, that it kills a kind of green fly which is very hurtful to the leaves of plumb trees and other fruit trees. It has been very generally known, that the smoke and the juice of tobacco were pernicious to different kinds of insects and worms; but it has not, so far as I know, been employed in Mr. Henderson's manner; and, as this has the advantage of not hurting the leaves, nor the fruit, I consider it as a useful and material improvement, and well entitled to a moderate premium."

## REMARK BY T. G. F.

The simple recipe above described would probably be effectual in destroying the caterpillars and other insects which infest apple trees, and other species of fruit trees.

# ACCOUNT OF SOME EXPERIMENTS

ON RAISING POTATOES FROM SEED, WITH REFLECTIONS ON THE SAME. BY MR. NEHEMIAH BARTLEY.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY FOR THE ENCOURAGEMENT OF AGRICULTURE, &c.

IT having been a prevalent opinion, that the potatoe produced from seed* would require several years for bringing it to a state of maturity or perfection, and, from my own observation, having had reason to think it might reach maturity within the first year, I was, in the last spring, induced to try the experiment.

I should have sown early in the month of April, had it been in my power to procure the seed; but it was with much difficulty I could get any, there being none in the Bristol seed shops; and by mere chance, I got a single ounce at one of the London shops. It was not, therefore, till the 19th of May, that I was enabled to sow the seed; which was done in drills, with two feet intervals. About a month afterwards, the plants were in a state to be removed from the seed bed; they were accordingly transplanted in drills, at the distance of about seven inches from plant to plant, with three feet intervals. And this, I imagine, is the most eligible scale for planting the potatoe in general, whether it be the seedling plants, or shoots from the bulbs. The earth in the intervals was drawn up, from time to time, to the plants, in proportion as they advanced in growth. About the beginning of September, they seemed to have acquired the usual size; and all the mould which the intervals afforded, had been applied to them.

About this time also, the plants began to put forth blossom; and, notwithstanding the unfavourable circumstance of the seed having been sown so late, I persuade myself the plants would have produced seed, had not a remarkably severe frost intervened, at a period of

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* In a former letter, Mr. Bartley says, "a notion prevails in Lancashire, and some other potatoe counties, that after a certain period, the cuttings, or off-sets, are apt to degenerate in quality, as well as in power of producing abundant crops; whereas it is thought that potatoes raised from seed, continue to improve in both respects for a considerable number of years."

the season uncommonly early, by which they were entirely cut off: yet a great number of the bulbs had acquired a mature size.

To those gentlemen who may be desirous of pursuing this experiment, I would recommend their sowing about the beginning of April; or even sooner in the season, were it not for the danger of frost, of which this exotick plant* is very susceptible.

Four ounces of seed would produce plants sufficient to stock an acre of ground, on the scale I have mentioned.

The soil on which these plants were raised, was a deep sandy loam, without the addition of any artificial manure.

It may be matter of future consideration, to what extent this mode of cultivating the potatoe may supersede the present one, of propagating by shoots from the bulb. But the more obvious advantages seem to be, the production of new, and perhaps better varieties; as well as by a timely recurrence to the seed, to renovate the species, which are generally understood to decline in prolificacy after certain removes therefrom, and that at no very distant period of time.

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## SPECIFICATION

### OF THE INVENTION OR DISCOVERY OF THE USE AND APPLICATION OF CERTAIN VEGETABLES FOR DYING, STAINING, PRINTING, AND PAINTING CERTAIN VALUABLE COLOURS.

FROM AN ACT OF THE BRITISH PARLIAMENT, MADE IN THE 25TH YEAR OF GEORGE III.

TO all to whom these presents shall come, &c. Now I the said Edward Bancroft, in obedience and conformity to the said act, do hereby particularly describe and ascertain the nature of my said invention, in its improved state, as followeth; I do declare, that the vegetables, of which I have invented or discovered the use and application, for the purposes of giving colour by dying, staining,

* Would not propagating by seed be the most effectual method of naturalizing it?

printing, and painting, as before mentioned, are the following three in number; *viz.* The first is a species of oak, growing spontaneously on the continent of North America, and particularly within the thirteen United States, in some of which, particularly in the Massachusetts Bay, it is commonly called *yellow oak*, and in others, particularly in Pennsylvania, *black oak*; being that species of American oak, which, in the writings of the celebrated Carolus Linnæus or Linné, is termed *Quercus nigra*, and which, in the Flora Virginica of Gronovius, is distinguished as *Quercus foliis cuneiformibus, obsolete trilobis, intermedio æquali.* The bark of this oak is the part most useful in giving colour: it is very rough, and of a dark brown or black colour on the outside, and of a light yellowish brown within; and may be distinguished from the bark of all other oaks, with which I am acquainted, by the following circumstances or effects; *viz.* if boiled in water, its decoction becomes yellow by the addition of alum, or if, instead of alum, a suitable quantity of green vitriol, or other solution of iron, by some other mineral or vegetable acid, be added, it produces a kind of olive, or olive-brown colour, instead of a black, which would be thereby produced with the decoction of any other kind of oak known to me. There are several varieties of this species of oak, all agreeing with it in giving a yellow colour by the help of alum, and I claim the exclusive right in dying, &c. of all the oaks, and varieties of oak, possessing this property. The bark in question may be most advantageously peeled or separated from the tree in the spring months; and, as its rough blackish outside part, making nearly half of the whole, contains little or no colouring matter, it may be shaved or cut off from the inner part; and this inner part, being thoroughly dried, and coarsely ground, may be closely packed and pressed in proper casks, and shipped; the spaces between the several casks being filled with pieces of the same bark, shaved, but not ground. The cargo which I imported, in the brigantine Industry, Henry Hubbs, master, from Philadelphia to London, in the year 1775 (at which time no other person had ever either imported or used this bark in Great Britain) was shaved, prepared, and packed in these ways, and I consider them as a part of this my invention. The bark, thus prepared and imported, I call *Quercitron* bark, a name composed of the Latin words *Quercus citrina;* the colouring parts and particles of this species of oak are of that class which Messieurs Macquer, Fourcroy, Morveau, and other French chymical writers, have called *Extractive savonneuse, ou gommeuse*, and are to be fixed in dying, &c. by what these writers, and the French generally, call *mordants;* a term which I here adopt from, and use in, the sense in which it is usually employed by them, signifying alum, and other mineral salts and metallick solutions; the earths of one or more of which, being previously conveyed, by an aqueous vehicle into the pores or interstices of the substance to be dyed or coloured, do attract the colouring particles of the *Quercitron* bark, &c. dissolved and applied in water, and do fix them, more or less indissolubly, in the substance thus dyed or coloured. The tingent particles of this oak, or *Quercitron* bark, very much resemble, in their properties and effects, those of the Weld or Would plant; the *Reseda Luteola* of Linnæus; and all the colours, and variations of colours, which are communicable by it to wool, silk, cotton, linen, &c. may be given, I think more advantageously, by the *Quercitron* bark, used in the same ways, and with the same means; excepting, that as this bark, separated from its outside useless part, as before mentioned, and powdered, will yield about ten times as much colour as an equal weight of the Weld plant, it must be employed in a proportionably less quantity; and excepting also, that no pot or pearl ash, or any other alkaline salt, is to be employed with the *Quercitron* bark, when either a yellow or green colour is wanted from it; and that, in those cases where tartar, or cream of tartar, is used along with alum, for dying silk or wool yellow or green by the Weld, the tartar is to be wholly omitted in giving those colours from the *Quercitron* bark, and the proportion of alum increased about one fourth part. This general explanation will enable the diers and calico printers to produce, from the Quercitron bark, all the colours and effects which have hitherto been produced by the Weld plant; but, to prevent the possibility of any mistake, I shall subjoin a few particular directions, though convinced that they must be unnecessary. The calico printer who would give a durable yellow from the Quercitron bark, instead of the Weld, must print or apply the same mordant, or composition of alum, sugar of lead, &c. (thickened as usual with gum) which is employed in fixing yellow from Weld, upon or to linen or cotton, prepared in the usual manner; which mordant, having remained and dried on the spots or figures intended to be made yellow, the usual time, is to be washed or rinsed off in the usual manner, and then to be died with the Quercitron bark (coarsely powdered) in the same manner as is practised with the Weld; using, however, only a tenth part of the weight of the Weld which would be requisite, and employing a moderate heat, in which the parts printed with the mordant will receive a very good yellow, while the rest of the linen or cotton is scarcely discoloured. When a boiling heat is used, and long continued, a portion of the resinous part of the Quercitron bark is thereby extracted, which, in some degree, tends to give the yellow a brownish hue, and the parts intended to remain white are unnecessarily discoloured, and consequently require longer bleaching; the process of which is to be conducted in the same manner, where the Quercitron bark has been used, as if the Weld had been employed. The The same mordant to figures, &c. previously dyed or stained blue with indigo, will afford a green colour from the Quercitron bark, by the same process as that which affords the yellow; and, when this mordant has been printed on a white ground, if, instead of the Quercitron bark, a proportion of prepared madder be used with it, in the same manner as for the yellow, a lasting orange colour may be produced, partaking more or less of the red, according to the greater or less proportion in which the madder is employed. If a suitable proportion of green vitriol, or what is called iron liquor, or of iron dissolved in the nitrous or the marine acid, be mixed with the mordant directed for the yellow, the Quercitron bark will, by the same process, give an olive, or an olive brown, with what the French call *Merde d'Oie*, carmelite, and other variations of that species of colour: and if the colour of the Quercitron bark is wanted to be still more saddened, the iron liquor alone may be used as the mordant; or, in its stead a solution of iron by either of the mineral acids, being first sufficiently diluted with water, and thickened with gum, as usual, may be employed. The calico printers may also give a considerable variety of earthy browns, snuff colours, &c. from the Quercitron bark, used in the same manner, by employing or substituting, as mordants, either of the several solutions of tin, bismuth, or lead, in nitrous acid (commonly called aqua fortis) or the solution of zinck in marine acid (commonly called spirit of sea salt) or in aqua regia, or in vitriolick acid (by which last what is called white vitriol will be obtained) or by employing a solution of regulus of antimony in aqua regia; in preparing either of these mordants, the acid is to be saturated with the metal or metallick substance (by being made to dissolve as much as it can retain of it) and the solution is afterwards to be diluted with water, so as that the acid may be thereby reduced, and made weaker than that of lemon juice, in order that it may not injure the linen or cotton to which it is to be applied. The mineral acids being prepared and sold of very different degrees of strength, it is impossible for me to specify exactly the proportions of the several metals or metalick substances abovementioned, which they are capable of dissolving or retaining; and it is equally impossible for me here to ascertain the exact proportion which will sufficiently dilute these different solutions; though in general a mineral acid of such strength as to neutralize about its own weight of clean, dry fixed vegetable alkaline salt will, when saturated with the proper metallick substance, as before mentioned, require near ten times its weight of water to dilute it sufficiently for printing, for which last purpose it is to be thickened with gum as usual. It may also be observed, that when either tin, or bismuth, is to be dissolved by the nitrous acid only, the acid should be previously diluted by two or three times its weight of water, and the tin, or bismuth, put into the acid by small quantities at a time, allowing the first quantity to dissolve before the second be added, otherwise the acid will act with so much violence as to calcine rather than to dissolve the metal. It is of great utility in the printing of linens or cottons, instead of applying the mordant previously, or separately from the tingent or colouring substance, to be able to mix and apply both together by the pencil, or by printing; and for this purpose the Quercitron bark may be made singularly useful. A pound of it powdered may be boiled with two or three quarts of water, so as that when strained, the decoction will be reduced to one quart, and this, being thickened with the usual proportion of gum, may be thoroughly mixed with one ounce and a half of spirit of sea salt (strong enough to neutralize its weight of pure fixed alkaline salt) in which as much tin as it is capable of dissolving by a moderate heat, has been previously dissolved, and also with one ounce of spirit or oil of vitriol of equal strength in which as much tin as it can retain has likewise been dissolved, and also with one ounce and a half of double aqua fortis, of equal strength in which as much lead as it can retain has been dissolved, and also with one ounce of that preparation of arsenick which Macquer calls *Sel neutre arsenical;* and this mixture being printed or penciled upon linen or cotton prepared in other respects as usual, and suffered to remain some days until thoroughly dried, before it be rinsed or washed, will afford the most beautiful high bright yellow, capable of resisting and even improving by, the action of lemon juice, and also of resisting the action of soap and water, even in a boiling heat, for a longer time than any of the fast yellows given even in any way, to linens or cottons from the Weld plant. And, though this yellow will acquire a brownish hue from exposure to the sun and air, it is by such slow degrees, and the stain is in other respects so durable, that this mode of employing the Quercitron bark will doubtless be highly useful to calico printers. It is a constant effect of tin, when dissolved by the marine acid only, and employed as a mordant, to produce with the Quercitron bark, a clear, lively, but palish yellow, which is not very durable. The same metal, dissolved in nitrous acid only, produces from the Quercitron bark a durable kind of nankeen brown; and, dissolved in the vitriolick acid, it produces from the Quercitron bark a yellowish brown. If either of the two last solutions of tin be mixed with an equal portion of the solution of that metal by marine acid, of equal proportionable strength (I mean capable of neutralizing an equal quantity of fixed alkaline salt) and this mixture be used as a mordant for the Quercitron bark, it will produce a colour better, and more lasting, than could be obtained by a solution of tin in marine acid only. If, instead of equal portions of the before mentioned solutions, a little more of the nitrous or of the vitriolick solutions of tin be added to the solutions of that metal in the marine acid, and this last mixture be employed as a mordant, and applied, either separately from the Quercitron bark, to the linen, cotton, &c. or mixed with a decoction of the bark, a most beautiful high bright yellow will be produced, which, in a very extraordinary manner, resists the action both of acids and of alkalies; but it is more liable to become brown from the sun and air than either of the preceding yellows. If, to a decoction of Quercitron bark, made and gummed as has been before described, a solution of iron by single aqua fortis be added as a mordant, this mixture, printed or penciled on linen or cotton, will afford different shades of lasting *Merde d'Oie*, olive, and olive-brown colours, according to the proportion of iron so employed; and if, instead of this mordant, a solution of bismuth, or of lead, in aqua fortis, or of zinck, or regulus of antimony, in aqua regia, be mixed with the same decoction, a considerable variety of earthy browns, snuff colours, &c. may be given, which will resist acids, soap, and the action of the sun and air, so as to be very useful to calico printers. These several metallick solutions, when intended for this use, are to be made in the same way, and employed in about the same degree of strength, as was directed when they were intended to be applied separately to the linen or cotton, instead of being mixed with the decoction of the Quercitron bark. The diers of linen and of cotton manufactures will hardly need to be told, that the same means which enable the calico printers to give stains or colours partially, will enable them, the dyers, to give the same stains or colours generally; and that the Quercitron bark, with the mordants proposed for fixing or varying its colour, will die all the colours, and shades of colour, before mentioned; with this difference, that it will always prove most advantageous to these diers, to apply the mordant, without gum, previously to the piece of linen or cotton to be died, and suffer it to remain some days, the more the better, so that it may be very thoroughly dried and consolidated in the pores of the linen or cotton before it be rinsed off; after which it is to be died as usual with the Quercitron bark, in powder, allowing about one pound of it to every nine or ten pounds which the linen or cotton weighed when dry. Or these diers, if they think it preferable, may use the Quercitron bark in the several ways in which they employ the Weld plant, and produce thereby the same effects, allowing for its superiour proportion of tingent matter, and avoiding, as has been before observed, the use of any fixed alkaline salt, and of tartar, where either a yellow or a green is to be produced. The same observation is to be repeated to the woollen diers generally, with one single example; *viz.* to die one hundred pounds of cloth, or of wool, of a bright, good, yellow colour, it is to be boiled the usual time, with the usual proportion of water, and about eighteen or twenty pounds of alum, but with neither tartar nor cream of tartar; after which, being slightly drained or pressed, the cloth or wool is to be removed to another suitable vessel, in which ten or twelve pounds of Quercitron bark, powdered and tied up in a suitable bag, shall have previously boiled for a quarter of an hour, with the usual quantity of water, with which the cloth or wool is to be died, in the same manner as is practised with the Weld plant, but without any alkaline salt, or lime. When weaker shades of yellow are wanted, the quantities of alum and of Quercitron bark are to be proportionably diminished. Cloth or wool previously died blue, of different shades, may in these ways acquire the various shades of green; or of orange, if previously died of suitable reds. In other cases, the colour of the Quercitron bark may be saddened and varied, by the woollen diers, by the several ways and means which they employ to sadden and vary the colours of Weld. Silk, prepared in the usual way, may be died of the several colours before mentioned from the Quercitron bark, by the same means, and in the same ways, as are directed for wool, but with less heat, as is usual; or it may be partially stained, or spotted, by the decoction of Quercitron bark, mixed with the several metallick solutions or mordants, mentioned for producing the like effects on linen or cotton. Hair and fur are to be died from the Quercitron bark, in the same manner, and by the same means, as are described for dying wool; and so is leather, excepting that care must be taken to employ but a very moderate heat with it. To stain paper yellow, a quart of decoction of Quercitron bark, made in the same manner, and of the same strength, as has been described for the calico printers, may be mixed with about half a pound of alum, and this, being dissolved, may be thickened and applied in the usual manner; or, if a more opake substantial colour be wanted, so much chalk, or calcareous earth, may be added to the decoction as will neutralize the acid of the alum in it. The other combinations and variations of this colour, may be produced by the same means which the paper stainers now employ, to produce the like effects with the other yellows commonly used by them. There is moreover contained in the Quercitron bark a resinous colouring part, which water alone cannot dissolve or extract, but which may be extracted by it, with the help of about one pound of American pot ash, or other alkaline salt of equal strength, to every twenty pounds of the bark, previously deprived of all the tingent matter which water alone can separate from it. Four or five pounds of linen, or cotton, or silk, or wool, boiled with resinous colouring matter thus extracted from a pound of the bark, and afterwards plunged into a sufficient quantity of vitriolick acid, diluted with water so as not to injure the linen, &c. will acquire a kind of nankeen colour, which seems to be sufficiently durable. The bark of the root of this species of oak, and its acorns, possess the same colouring properties as the bark of the trunk and branches, but in different proportions; the former being considerably more abundant than the latter in colouring matter.

The second of these vegetables is the North American hiccory or walnut tree, termed by Linnæus *Juglans alba;* and described in the Flora Virginica of Gronovius as *Juglans alba*, *fructu minori*, *cortice glabro*, and also as *Juglans alba*, *fructu ovato compresso*, *nucleo dulci*, *cortice squamoso*. There are several other species or varieties of this hiccory, the barks of which afford a yellow colour when boiled in water with alum, and I mean hereby to secure the use of all which are distinguished by this property; which the rinds of the nuts, and the bark of the roots, of this tree, likewise possess. The tingent matter of the hiccory is of the same nature as that of the Quercitron bark, and is to be communicated or used, varied, and fixed, by the calico printers, diers, paper stainers, &c. in the same ways, and by the same mordants, as have been described for using, varying, and fixing the colours of the Quercitron bark, in or upon wool, silk, linen, cotton, paper, &c. Observing, however, that the hiccory bark affords about one fourth less of colour than the Quercitron bark, and that it is less suitable for mixing directly with the several mordants, and printing or penciling on linens or cottons, as is directed to be done with the decoction of Quercitron bark. The hiccory bark may be powdered, without separating its outside part, and pressed into proper casks, and thus imported for use.

The third of these vegetables is the red mangrove, growing spontaneously near the sea, on the continent and islands of America, and in other parts of the globe, between the tropicks of Cancer and Capricorn. It is the *Rhizophora Mangle* of Linnæus, described by Sloane, Ray, and other botannick writers, as the *Mangle pyri foliis*, *cum siliquis longis*, *ficui indiciæ affinis*. The bark of this tree is of a reddish-brown colour, excepting only a very thin external coat, which cannot be easily separated from the inner part, and therefore may be ground

ground with it when thoroughly dried ; and they may be packed, and imported, as is directed for the hiccory bark. As a colouring substance, the red mangrove bark is of the class of those whose tingent particles Monsieur Macquer, in his *Dictionnaire de Chymie*, describes as residing partly in a substance *savonneuse extractive*, and partly *terreuse et resineuse*, and therefore its colour may be extracted by water only, and communicated and fixed in wool, silk, linen, cotton, &c. without the help of any mordant whatever ; I think, however that the colour of the mangrove bark is better extracted, and considerably improved, by adding pot or pearl ashes to the water in which it is boiled, at the rate of about one pound of pot or pearl ashes for every thirty pounds of bark. Thus extracted, the colour of the mangrove may be permanently fixed in wool, silk, linen, cotton, &c. in the most simple manner, without the use of any mordant whatever. One hundred pounds of wool, or of cotton, or linen may be thus dyed of a reddish brick colour, by being only boiled with five pounds of the mangrove bark, powdered, and two ounces, of American pot or pearl ashes ; and the same quantity of silk may be also died by the same means, taking care only to employ a more moderate heat. One pound of mangrove bark, boiled with a thirtieth part of its weight of pearl ashes, in a gallon of water, until the decoction, when strained, is reduced to three pints, or two quarts, being thickened with gum, may be printed or penciled upon linen or cotton, and will thus give lasting stains, capable of resisting the action of acids, of soap, and of sun and air, for a long time. The colour of this decoction may however be improved, varied and, I think, rendered still more durable, by the help of the several mordants directed for varying and fixing the colour of Quercitron bark. The solutions of iron, in different proportions, sadden, and if used in sufficient quantity, produce a black, with this decoction of the mangrove bark. About an ounce of *Sel neutre arsénical* of Macquer, dissolved in a quart of the same decoction, seems to give the colour more body and permanency. Lead dissolved in aqua fortis, and mixed with this decoction, adds to the beauty and permanency of its colour. Tin dissolved in vitriolick acid, and also in aqua regia, produces useful variations of its colour ; as does bismuth dissolved in nitrous acid, and indeed all the other mordants directed for the Quercitron bark. But as words can convey but imperfect ideas of the variations produced by them, and as some of their variations are very inconsiderable, it would be useless to attempt a more particular description of their effects, which may be seen by any person who will make the experiments. The calico printers, who would thus print and pencil the colours of the red mangrove, may observe the directions already given, respecting the preparations and proportions of the several metallick solutions, or mordants, to be mixed with the Quercitron bark. The diers of wool, silk, linen, and cotton, may advantageously employ all the several mordants, and also alum, and sugar of lead, to fix and vary the colours of the mangrove; and may employ them, either previously applied to the substance to be died, or mixed with the colouring matter of the mangrove, in the proportions and ways directed for the Quercitron bark; allowing only for this difference, that the mangrove contains about twice as much colouring matter as the Quercitron bark. The colouring matters of the foregoing vegetables, mixed with each other, and with other dying drugs, and fixed by the mordants herein before mentioned, are capable of producing many other variations of colour, which those acquainted with the principles of dying and combining colours will readily perceive. Indeed almost every argillaceous and metallick solution which chymistry affords, is more or less capable of varying and of fixing the colouring matters of the preceding vegetables, though it would be useless and endless to point out all the ways in which these solutions may be employed or combined for that end; those which I have already specified are probably more than will ever be practised, and they are the most useful results of several thousands of experiments. In witness whereof, &c.

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## OBSERVATIONS

RELATIVE TO PRUNING ORCHARDS, BY THOMAS SKIP DYOT BUCKNALL, ESQ. OF CONDUIT STREET, LONDON. ABRIDGED FROM THE TRANSACTIONS OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS.

THE silver medal of the society was voted to Mr. Bucknall, for these Observations.

The bark of trees consists of three divisions; the outer, rough; the middle, soft and spongy; the inner, a whitish rind, being that which joins the bark to the wood; and this last is supposed to contain the liquid sap. When the stem of the tree grows too fast for the bark, it causes blotches and lacerations; which are avoided by scoring the bark with a sharp knife; but care should be taken not to cut through the whitish rind before mentioned; for that heals with difficulty and generally ulcerates, and being cut through gives insects an opportunity of getting between the wood and the bark, when they are very destructive.

Any surgeon knows that a wound extending to the fine membrane, covering the bones of the human body requires much more skill to cure than a flesh wound, and the case is similar.

In pruning, this writer directs that no branch should be shortened unless for the figure of the tree, and then taken off close at the separation, by which means the wound soon heals. The more the range of the branches shoots circularly, a little inclining upwards, the more equally will the sap be distributed and the better will the tree bear; for from that circumstance the sap is more evenly impelled through every part. The ranges of branches should not be too near each other; for all the fruit and the leaves should have their full share of the sun; and where it suits, let the middle of the tree be free from wood, so that no branch shall ever cross another, but all the extreme ends point outwards.

It is impossible the bark can grow over a stump, because there is no power to draw the sap that way; for which reason always cut a little within the wood, and cut quick and smooth. When the leaves curl the fruit is always specky. All the branches should be left as nearly equidistant as possible, without attention to the beauty of the head. Blotches should be opened and scored; and where the bark is ragged from any laceration it should be pared down gently to the live wood. Each of these should be touched gently with the medicated tar hereafter to be described. In cutting the surgeon's rule should be followed, go to the quick, but do not wantonly make a wound larger than is necessary. If a branch be in such a position that in the course of two or three years it would be in the way the sooner it is cut off the better.

When trees are much thinned they are subject to throw out a great quantity of young shoots in the spring which should be carefully rubbed off and not cut, for cutting increases the number.

The medicated tar, which Mr. Bucknall rubbed over the wounds which were made by the bill and pruning knife, was composed of an ounce of corrosive sublimate reduced to fine powder, by beating with a wooden hammer, and then put into a three pint earthen pipkin, with about a glass full of gin or other spirit, stirred well together, and the sublimate thus dissolved. The pipkin was then filled by degrees with vegetable or common tar, and constantly stirred till the mixture was blended together as intimately as possible; and this quantity will at any time be sufficient for two hundred trees.

To prevent danger, let the corrosive sublimate be mixed with the tar as soon as possible after it is purchased; for, being of a very poisonous nature to all animals, it should not be suffered to lie about the house, for fear of mischief to some part of the family.

## OBSERVATION BY T. G. F.

The preceding paper cannot fail to prove of great practical utility. I would merely suggest in addition, that in "scoring the bark," or preventing the tree from being what the farmers style "*hide bound*" a *guaged instrument*, or a sharp instrument with a *guard* to prevent cutting too deep, and thus injuring the rind, which immediately embraces the body of the tree might, perhaps be found useful.

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## GLUE.

FROM THE HISTORY OF THE PROGRESS AND PRESENT STATE OF ANIMAL CHYMISTRY—BY W. B. JOHNSON, M. P.

AT the article *Gelatin*, it is observed, that it is particularly from the white parts of animals that it is extracted, but as it was not intended, on discussing the component parts, to make any application of them to the arts, an account of the making of glue, and other circumstances attending it were reserved for the present.

Glue has nearly all the properties of Gelatin; the difference, according to Fourcroy, consisting only in the consistence. Gelatin has less viscidity and tenaciousness, being more particularly obtained from young animals; whilst glue, on the contrary, is only obtained from old animals, whose fibre has become drier and more strong.

According to du Hamel du Monceau, who has written perhaps, the best work on the subject, glue was principally prepared from a solution of the membranous, tendinous, and cartilaginous parts of animals; they were dried, and afterwards melted into tablets.

It is however found, that all animal substances containing jelly, are capable of being made use of in the manufactory of glue; and du Hamel likewise informs us, that hartshorn and bones, after having been dissolved in Papins's digester, afforded a glue of great strength, but of a black colour.

That glue might be extracted from bones, we are informed by Papin himself. In the edition of his works printed in 1782, it is said, that, by means of his digester, he had not only prepared a jelly from bones, but also from ivory, with which he had glued together some pieces of broken glass: and from experiments that have been since made upon them, it appears they contain it in a considerable quantity.

Spielman has added a good deal of information to that found in Papin on this subject. According to this chymist, he has extracted glue, or dry jelly, not only from the bones, but all the hard parts of animals, simply by ebullition; that he procured more or less of it from the teeth of the wild boar, those of the sea horse, and likewise from the wood louse and the viper.

There are several sorts of glue made in Europe. The English glue is esteemed the best; it is of a brownish red colour. The hardest is looked upon as next in point of goodness; it is whitish and transparent, whilst the most ordinary is made at Paris, and is black and opaque. The reason of this difference according to Lewis, arises from the Flemish and French employing bones and sinews, which do not afford so strong a glue as skins from which the English manufacture their glue. According to this chymist, the method of preparation is, to steep and wash the parings or cuttings of the hides in water; they are then boiled with fresh water till the liquor grows thick, when it is strained through baskets, suffered to settle, and afterwards further evaporated, till on being poured into flat moulds, it unites on cooling, into solid cakes, which are cut in pieces and dried upon a kind of net.

Grenet has been occupied for several years with the melioration of this substance. He began by reading every thing already written on the subject; meditated very much on the qualities of the substances employed, and submitted to experiment those which had not been made use of, and which appeared to him to be proper for its preparation. Bones, however, produced it abundantly, and with great facility. He first deprived them of their fat, and procured the jelly by simple ebullition; and this, when converted into glue by drying, he found to be much superiour to the French kind, and nearly equal in goodness to those of the best markets.

Parmentier, and Pelletier, who have also made experiments, tending to the same end, obtained from six pounds of the raspings of the button makers, one pound of glue, similar to the English sort. From the raspings of ivory the glue was equally as good. The raspings of horn they found to afford no glue.

As jellies acquire more or less colour by exposure to heat, on being brought to a proper state of exsiccation, to procure glue as little coloured as possible, the less time it is exposed to heat the better; hence, by using only a small quantity of water to extract the jelly, a less evaporation is necessary to concentrate it, so as to form that substance on cooling, and consequently a less exposure to the fire; and if the jelly be afterwards cut into thin tablets or cakes, they will likewise be more easily dried. To following this plan the Flanders glue is said to owe its whiteness and transparency; whereas by much exposure to heat the parts become carbonized and black.

Glues differ from each other in their consistence, colour, savour, odour, and solubility; some of them dissolve very readily, when agitated in cold water, others are only soluble in boiling water: the best ought to be transparent, of a yellow inclining to a brown colour, without odour or savour; it should be perfectly soluble in water, forming a viscuous fluid with it of an uniform consistence, and which on becoming dry, preserves equally, in every part, its tenacity and transparency, and, in general, attains more solidity, colour, and viscidity, according to the age and strength of the animal from which it has been extracted.

Clennel has given the most minute account of the making of glue, which was obtained during a visit to a manufactory in Southwark. He informs us, it is made from the parings of hides, horns of different kinds, pelts from furriers, and the hoofs and ears of horses, oxen, calves, sheep, &c. quantities of which are imported in addition to the home supply, by many of the great manufacturers of this article. These are first digested in lime water, to cleanse them, as far as it can, from any grease and dirt; they are then steeped in clean water, stirring them well from time to time; they are afterwards laid in a heap, and the superabundant water poured out; they are then boiled in a large brass cauldron with clean water, skimming off the dirt as it rises, which is further cleaned by putting in, after the whole is dissolved, a little melted alum, or lime finely powdered, which by their detersive properties, still further purge it; the skimming is continued for some time, when the mass is strained through baskets and suffered to settle, that the remaining impurities, if any, may subside; it is then poured gently into the kettle again, and further evaporated, by boiling a second time, and skimming, until it becomes of a clear but darkish brown colour, when it is thought to be strong enough (which is known either by the length of time a certain quantity of materials have boiled, or by its appearance during ebullition) it is poured into frames and moulds about six feet long, one broad, and two deep, where it hardens gradually as the heat decreases; out of these troughs or receivers, it is cut, when cold, by a spade, into square pieces or cakes, and each of them placed within a sort of wooden box, open in three divisions to the back; in this the glue, as yet soft, is taken to a table by women; where they divide it into three pieces (when by mistake, they cut only two, that which is double the size is called a bishop, and thrown into the kettle again) with an instrument, not unlike a bow, having a brass wire for its string; with this they stand behind the box, and cut by its openings from front to back; the pieces thus cut, are taken out into the open air, and dried on a kind of coarse net work, fastened to moveable sheds of about four feet square, which are placed in rows in the glue maker's field (every one of which contains four or five rows of net work ;) when perfectly dry and hard it is fit for sale. According to Lelernel, that is thought the best glue which will swell considerably without melting, by three or four days immersion in cold water, and recover its former dimensions and properties by drying. Glue that has got frozen, or that looks thick and black may be melted over again and refined, with a sufficient quantity added of fresh, to overcome any injury it may have sustained ; but it is generally put into the kettle after what is in it has been purged in the second boiling. To know good from bad glue, the purchaser should hold it between his eye and the light, and if it appears of a dark brown colour, and free from cloudy or dark spots, the article is good.

A superiour and colourless glue, called *size*, is obtained from eel skins, vellum, parchment, and some of the white kinds of leather, &c. but this is much too expensive for common use, and is only employed by those artificers whose work requires so delicate a substance, and where glue would be too gross. Such as use size, are the paper maker, the linen manufacturer, the gilder of gold, the polisher, and the painter in various colours, &c. For the same purpose the skins of the cat, rabbit, and hare, are employed.

Hatchet, in his experiments to investigate the composition of membrane, obtained various quantities of gelatin, and when the solutions of it were gradually reduced by evaporation, has had opportunities of frequently observing the various degrees of viscidity and tenacity, which characterize mucilage, size, and glue. The difference in the viscidity and tenacity of the varieties of these substances, is, according to this chymist, evidently an inherent quality, and not caused by the degree of inspissation ; for if this was the case, mucilage, size, and glue, he thinks, would be of equal quality, which is contrary to experience ; for the varieties of glue are not of equal tenacity. Glue made from certain parts of animals, such as the skin, being more tenacious and of better quality than that which is made in some places from feet and sinews. It differs also according to age ; for the best and strongest glue is always obtained from the more aged animals, in whom the fibre is found to be most coarse and strong. But a longer continued boiling appears requisite to extract it, and the more viscid glues are obtained with greater difficulty, than those of a less viscid quality, which may more properly be called size, and this difference is to be observed, when muscle is boiled with repeated and frequent changes of water. Gelatin thus obtained, whether in the state of mucilage, size, or glue, when completely dried, is affected by water according to its degree of viscidity; for when cold water is poured on dry mucilage, it dissolves it in a short time; but if cold water is poured on these varieties of gelatin which when dissolved in a proper quantity of boiling water, would, by cooling, form jellies more or less stiff, it acts on them in different degrees, not so much by forming a complete solution, as by causing them to swell and become soft; so that when a cake of glue has been steeped three or four days in cold water, if it swell much without being dissolved, and, when taken out, recovers its original hardness and figure, by drying, such glue is considered to be of the best quality.

The animal mucilage, which Hatchet employed, was obtained from the corall. officin. as he found it to be pure, and not partly modified into gelatin or animal jelly; or in other words, the mucilage had not acquired the degree of viscidity requisite to form a gelatinous substance. The expression is not therefore to be understood as alluding to any essential difference in composition, but only to denote some variation in the degree of consistency; for the whole may be comprehended under the term gelatin (vide art. gelatin) of which mucilage may be regarded as one extreme, and the strongest and most viscous glue as the other.

As the qualities of gelatin are so various, so the properties of the substances, in which it is present as a component part, are much influenced by it; and when, for example, skins of different animals are compared, he always found, that the most flexible skins afforded gelatin more easily, and of less viscid quality than those which were less flexible, and of a more horny consistency. The skin of the eel possesses great flexibility, and it affords gelatin very readily, and in large proportion. The skin of the shark also, which is commonly used by cabinet makers to polish their work, was also soon dissolved, and formed a jelly like the former. The thin and tender epidermis or cuticle of these skins, although not soluble, was separated into small particles by violent ebullition, and the spiculæ were also separated.

The skins of the hare, rabbit, calf, ox, and rhinoceros gave the same results ; but gelatin from the hide of the rhinoceros appeared the strongest and most viscid. In every one of the experiments, the true skin, or cutis, was principally affected (as Chaptal and Seguin have observed) by long boiling, but that of the rhinoceros far exceeded the others in difficult solubility. The cutis of these skins, when first boiled, swelled and appeared horny ; it was then gradually dissolved ; but in the cutis of the rhinoceros, a few filaments remained, which at length contracted and adhered to the cuticle. The cuticle of the different skins was softened, but not dissolved ; and as the cutis seems to be entirely formed of gelatin, so the cuticle appears to contain it, although in a small proportion. It is however, necessary to its flexibility; for when, after long boiling, the cuticle of the skin was dried, it became a brittle substance, which was easily reduced to powder.

Hair was much less affected than skin. The cartilages of the articulations are as completely soluble as the cutis, when long boiled with water ; but this is not the case with the other cartilages ; the others afforded little or none. It was the same with respect to quill shavings, and the horns of different animals, which were next subjected to experiment, and all afforded small quantities of gelatin, and the more flexible horns the greatest quantity, with the greatest ease, and, when deprived of it, and suffered to dry spontaneously, in the air, they become more rigid, and were easily broken. The horns were those of the ox, ram, goat, and chamois, which are perfectly distinct from the nature of stag's or buck's horn; for this is as different from the former, in chymical composition, as in construction. Like bone, it affords much phosphate of lime (vide bone) and like it, a large quantity of gelatin; and it is observed by Hatchet, that phosphate of lime is generally accompanied by gelatin, as in stag's horn, bone, ivory, &c. On the contrary, when carbonate of lime is the hardening substance, as in shells, madrepores, and millepores, no gelatin can be discovered; for he has frequently digested the substances many days in boiling distilled water, after having reduced them to a coarse powder, that they might present a large surface, and never could discover the slightest vestige of gelatin. Hence the above horns are very different from the composition of stag's horn, and yield gradually, and with great difficulty, only a small quantity of gelatin.

Human nails and shavings of a hoof, long digested for several days, afforded like quill, only a slight cloud by nitro-muriate of tin. Tortoise-shell, in small thin slips and shavings, was affected in a similar manner.

Sponges and gorgoniæ, bladder, and other membranes afforded more or less gelatin.

He found the effects of dilute nitrick acid on the substances he subjected to experiment for the obtaining of glue exactly kept pace with those of boiling water, of which he gives an instance of two pieces of skin recently taken from the ox, one of the pieces was boiled in water till the whole of the cutis was dissolved; after which the cuticle remained, although very feeble in texture, while the hair did not seem to have suffered any material alteration. The other piece was steeped in nitrick acid, diluted with about four measures of distilled water. At the end of five days the cutis was dissolved, and the cuticle was become of a loose and feeble texture, but the hair had not suffered any apparent change excepting that of being slightly tinged with yellow. In both cases, therefore, the effects of boiling water, and of acid, were similar; and he found them to be more powerful on those parts which were the most gelatinous; and as water dissolves mucilage more speedily than size, and this last more speedily than strong viscid glue, so are the effects of very dilute nitrick acid on the same substances.

With respect to economical purposes, all animal substances whatever (exclusive of carbonate and phosphate of lime) may be converted into two substances of much utility, viz. glue and soap, with the additional advantage that those parts which would be rejected in making the one, are the most proper to prepare the other. The offensive smell of Chaptal's soap is considered as an objection, but this may be removed by exposing the soap for some time in flat vessels to the air: after which it may be reduced to the proper degree of consistency by a second boiling.

# ACCOUNT OF THE PROCESS

USED BY MR. ACHARD, FOR EXTRACTING SUGAR FROM BEET ROOT. AS COMMUNICATED BY HIM, IN A LETTER TO MR. VAN MONS.

FROM THE ANNALES DE CHIMIE.

MY labours respecting the fabrication of European sugar have prevented my writing to you sooner. They have employed me, and still employ me, so much, that I have very little time to spare for other objects ; but, as I know that the subject is interesting to you, I am anxious to take the first opportunity of giving you some account of it.

The species of beet proper for making sugar is the *Beta Vulgaris* of Linnæus ; but all the varieties of that species are not equally proper. That of which the inside is white, the skin pale red, and the root long and spindle shaped, is the best. Every kind of beet yields sugar, but that above described should be made choice of, when we wish to fabricate this substance advantageously; in other respects, the quantity of sugar furnished by the root depends entirely on the mode of cultivation.

It follows, from the process on the fabrication of sugar from beet root, which I executed under the inspection of a committee appointed by the king (of Prussia) that the best method is, to boil the root (with the skin, as it is taken out of the ground, and without any other preparation than that of carefully taking away the leaves and the heart) in water, till it is so soft that it may be penetrated by a straw. A short boiling is sufficient to produce this degree of softness, which is very well known to confectioners, and is given to several sorts of fruit, before they are preserved. The beet root, after cooling, is divided, and cut into slices, by means of the machine made use of by husbandmen for dividing potatoes for the use of cattle. This machine is described, and a figure of it given, in Busch's publication, intitled, *Uebersicht der fortschritte in wissenschaften, kunsten, manufacturen, und handwerken, von Ostern* 1796 *bis Ostern* 1797. Erfurt 1798. This method of dividing the root is the best I have hitherto discovered. Two men, with the assistance of the machine, can cut nearly 100 lb. of roots into very thin slices in three minutes.

In order to extract the juice from the roots, after being sliced, they are submitted to the action of a press, which ought to act very strongly, that as much juice as possible may be drawn from them. The pulp remaining in the press still contains a considerable portion of sugar, which it is worth while to extract from it. For this purpose, the pulp is to be mixed with a sufficient quantity of water, and, after twelve hours, the liquor is to be pressed out. After this second extraction, there still remains in the pulp a sufficient quantity of sacharine matter to furnish, advantageously by means of fermentation, either brandy or vinegar.

The liquors obtained by expression are to be mixed together, then strained through flannel, and afterwards evaporated, by continual boiling, to about two-thirds. They are then to be passed a second time through a woollen cloth, or through a very close kind of cloth made use of in refineries: and the strained liquor is to be boiled, in a vessel smaller than the first, till it is reduced to one half.

The liquor must afterwards be strained a third time, and boiled, in a still smaller vessel to the consistence of a thin syrup. It is here necessary to observe, that by giving the syrup too thick a consistence, there is a risk of spoiling the whole.

This syrup, after being poured into shallow earthen vessels, which present a large surface to the air, is to be placed in a stove heated to from 80 to 100, or even to 180 degrees, of Fahrenheit, that it may crystalize. During this insensible condensation of the syrup, the crystaline crust which is formed on its surface, is now and then to be broken; this, by assisting the evaporation, very much hastens the crystallization. From the moment it is observed that, instead of the crystalline crust, there forms on the top of the syrup a thick and gummy pellicle, which does not appear granulated, it is a sign that the substance no longer crystallizes, but merely grows dry, and the evaporation should then be stopped. What remains is a mixture, more or less thick, of a chrystalline substance and a fluid but viscid matter.

To separate the crystallized sugar from the glutinous extract, the whole must be put into a bag made of close cloth, and previously wetted; it must then be submitted to the action of a press, gradually increased. The sugar remains in the bag, and the extractive part passes through it. This sugar, after being dried, is a yellow muscovado, composed of regular crystals, and, when pulverized, forms a white powder of a very good taste; it is perfectly sweet, and may be applied to a number of purposes for which refined sugar is used. By refining this muscovado, sugar of any quality that is wished for may be obtained; the operation being repeated, according to the degree of purity desired.

The whole of the waste parts arising from this process, that is to say, the root which has been pressed, the liquor which passes through the bag upon pressing the crystallized sugar, the washings, &c. &c. are all very useful, and a great quantity of very good rum or brandy may be procured from them, which may be used in making the finest *liqueurs*

The muscovado, in the state in which it is obtained from the first operation, costs about one groschen and a half, of Prussia (about two-pence halfpenny) per pound, without reckoning all the advantages which may be derived from making use of the waste parts. By taking these into the account, and bringing the manipulations to greater perfection, which I shall endeavour to accomplish this winter, I am persuaded, that our European muscovado will not cost more than half this price, or nine pennings (about five farthings;) or, even in countries in which fuel is much dearer, one groschen (about seven farthings.)

The distillation of spirit from the waste parts is a matter of great importance; as by that means a great saving of grain will take place; and the making of sugar from the beet root, which will deliver Europe from an oppressive monopoly, becomes, on that account, still more interesting.

I am now endeavouring to discover a method by which the juice of the roots may be poured, after being sufficiently condensed, into moulds or forms, in order that it may acquire immediately the figure of a sugar-loaf, and that it may, by claying, become perfectly white in one operation. I have already found several methods by which it appears that this end may be obtained by a very short process. This new manipulation will very much facilitate the making of the sugar, and will consequently diminish the price of it.

## ACCOUNT OF AN EXPERIMENT

MADE TO DISCOVER WHETHER WHOLE POTATOES OR CUTTINGS ARE PREFERABLE FOR PLANTING, WITH SOME OBSERVATIONS ON TAKING UP POTATOE CROPS. BY MR. JOSEPH WIMPEY, OF NORTH ROCKHAMPTON.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY FOR THE ENCOURAGEMENT OF AGRICULTURE, &C.

EARLY in the spring of this year, I had a large quantity of potatoes, out of which I selected forty-eight bushels of the fairest for sets. The ground intended for them, the summer before, had born oats and vetches, which were mowed green, and given to the horses in the stables; after which, it was depastured till January. It was then clean ploughed, and lay till the end of March. Twenty-four cart loads of long dung, forty bushels to the load, where then spread over it equally; and furrows were drawn the lengthway of the field, at a yard distance from each other. In eleven of these furrows, containing sixty perches or poles, were dropped fourteen bushels of whole or uncut potatoes, the size generally from a large pullet's egg to that of a goose. The remainder of the ground, being 265 poles (making in the whole 325 poles, or two statute acres and five poles) was planted with thirty-four bushels of cut potatoes, being the remainder of the forty-eight bushels. These were cut mostly out of large potatoes, in pieces about the size of a large pullet's egg. The largest were cut into six or eight pieces, the less into four; being careful to preserve a proper number of eyes or buds in each cutting. The sets of both cut and uncut were planted about fourteen inches asunder, in the rows. The furrows were turned out with a plough having a double mould-board, and, when planted, were completely covered, by running the same plough up the middle of each interval, which threw the mould half one way and half the other; this is the speediest, easiest, and cheapest method of planting I am acquainted with. The ground was planted the fourteenth and fifteenth days of April.

In June they were horse-hosed, with a small one-wheeled plough, which I keep for horse-hoeing; and this was all the labour and expense bestowed upon them during their growth.

The 30th of October, the taking of them up was completed. The whole produce was only 378 bushels; a very indifferent crop! little more than half the produce per acre of last year. The expense of ploughing them up, harrowing, dragging, picking up, loading, carrying home (about a quarter of a mile) unloading, and carrying into the barn, &c. was not quite three pence a bag, or one penny a bushel. The state of the account, in a comparative view, I make out as follows.

The measure of all the ground planted was 315 poles: the whole produce was 378 bushels. The measure of the ground planted with *cut* potatoes was 265 poles: the produce 312 bushels. The ground planted with whole or *uncut* sets was 60 poles; and the produce of the same was 66 bushels.

Now, if 325 poles, the whole measure of the ground planted, produced 378 bushels, then 265 poles should produce 308 bushels (I omit the fractions;) but this quantity of ground, planted with cut potatoes, produced nearly four bushels more, that is, 312 bushels. Again, as 325 poles produced 378 bushels, 60 poles should have produced 69 bushels and a fraction; but it produced only 66 bushels, which is upwards of three bushels short of its proportion. It is true, the difference is too trivial to be worthy of notice; but what it is, is in favour of the cut potatoes. With respect to the produce per acre then, it is a matter of little importance whether the ground be planted with *cut* or *uncut* potatoes.

The produce per acre being nearly the same, whether planted with whole or cut potatoes, the great and interesting comparative question remains, viz. What is the difference of the expense in the planting of cut or uncut potatoes? this is very satisfactorily ascertained as follows.

If 48 bushels, the whole quantity of sets used, produced 378 bushels, then 34 bushels, the quantity cut, should produce 267 bushels; but they produced 312, which is 45 bushels more than the proportion. Again, if 48 bushels produced 378 bushels, then 14 bushels should have produced 110 bushels; but 14 bushels of uncut produced only 66 bushels, which is 44 bushels less than the proportion. A preference of 40 per cent. in favour of cut potatoes, in comparison with whole sets!

By this statement it clearly appears, that any quantity of land planted with potatoes cut into pieces of the size above mentioned, will, *cæteris paribus*, produce as great a crop as an equal quantity of land planted with uncut potatoes, the weight of which should be forty per cent. more : for example.

To plant a statute acre with potatoes, as above, would require, of uncut, 37 1-2 bushels ; of cut, only 20 1-2 bushels , the difference nearly seventeen bushels ; which at two shillings and four pence per bushel (the price they sold at in March last) amounts to one pound nineteen shillings and eight pence. An object much too considerable to be neglected by the planter of many acres, even when the price may be as low as three shillings a sack.

N. B. Potatoes in this country are usually sold by the bag. By a bag is understood a sack which will hold four bushels of corn, nine gallon measure, which they fill as full as they can, leaving room to admit of its being tied ; and the usual weight is twelve score or two hundred and forty pounds. This sack holds three bushels of potatoes heaped.

The foregoing experiment was conducted with all imaginable care and precision ; the facts are truly stated, and the writer hopes the calculations are just.

P. S. In class 3, article 4, a premium is offered to the inventor of the best new constructed plough for ploughing up potatoe crops, by which the work may be done with the least loss, or damage to the crop. As my method of taking up potatoe crops is not attended with the least loss or damage, and is, I conceive, as expeditious and as little expensive as can be desired, I request leave to lay it before the Society.

As observed before, I plant my potatoes in rows, with intervals of about three feet, for the convenience of horse-hoeing them. When the haulm is decayed, I proceed to take them up in the following manner, with a common foot or one wheel plough, much used in this part of Hants, and in Wilts ; the ploughman (having first taken out the coulter, and adjusted the wheel so that the point of the share may be deep enough to pass under the bed of potatoes) begins at one end, just under the middle of the row, and with one furrow turns them out on the surface of the ground. Two or three boys or girls follow the plough, and pick them up as they appear ; so that the ground of one row is cleared before the ploughman has finished another; and thus they proceed, without the least hindrance or interruption to each other.

When the whole is ploughed and picked in this manner, a pair of drags is run over the whole, which separates and exposes the potatoes that may happen to adhere to the clods of earth, which are then also picked up, and the ground nearly cleared. The season being now come for sowing wheat, the ground is clean ploughed, and the few potatoes that may possibly remain fully exposed to view, which being also picked, the ground is rendered very clean. In this way, the whole expense of harvesting the crop is little more than picking up and carrying home; for the expense of ploughing, &c. is little, if any, more than would have been incurred in tilling the ground equally well for the wheat crop.

Now I think it impossible, by any invention or device whatever, to take up a potatoe crop with less loss or damage. The crop of the above experiment was taken up under my own eye; and I can with great truth and confidence aver, that there was not so much as a single gallon bruised, cut, or damaged, in any degree whatever.

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## DESCRIPTION

### OF THE METHOD OF PREPARING OIL-COLOUR CAKES; INVENTED BY MR. GEORGE BLACKMAN, OF HEMMING'S ROW, LONDON.

FROM THE TRANSACTIONS OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, &C.

THE greater silver Pallet and twenty guineas were voted to Mr. Blackman, for discovering to the Society for the use of the publick, his method of making the above mentioned cakes.

Take of the clearest gum mastick, reduced to fine powder, four ounces; of spirit of turpentine, one pint; mix them together in a bottle, stirring them frequently till the mastick is dissolved; if it is wanted in haste, some heat may be applied, but the solution is best when made cold. Let the colours to be made use of be the best that can be procured, taking care that, by washing, &c. they are brought to the greatest degree of fineness possible. When the colours are dry, grind them on a hard close stone (porphyry is the best) in spirit of turpentine, adding a small quantity of the mastick varnish. Let the colours so ground become again dry; then prepare the composition for forming them into cakes, in the following manner. Procure some of the purest and whitest spermaceti you can obtain; melt it over a gentle fire, in a clean earthen vessel; when fluid, add to it one third of its weight of pure poppy oil, and stir the whole well together; these things being in readiness, place the stone, on which your colours were ground, on a frame or support, and, by means of a charcoal fire under it, make the stone warm; next grind your colour fine with a muller; then, adding a sufficient quantity of the mixture of poppy oil and spermaceti, work the whole together with a muller, to a proper consistence; take then a piece, of a fit size for the cake you intend to make, roll it into a ball, put it into a mould, press it, and it will be complete.

When these cakes are to be used, they must be rubbed down in poppy or other oil, or in a mixture of spirit of turpentine and oil, as may best suit the convenience or intention of the artist.

N. B. It may be proper to observe, that Mr. Blackman's colours in bladders are prepared with a mixture of spermaceti, and differ from his cakes only in having a larger proportion of oil.

At the end of the foregoing description are testimonies from Mr. Cosway, Mr. Stothard, and Mr. Abbot; stating that Mr. Blackman's oil-colour cakes, work as well as other oil-colours; that their drying without a skin upon the surface is a great advantage; and that Mr. Blackman's invention is, upon the whole, an essential improvement in oil painting.

# NEW KIND OF PAINT,

## PROPOSED AS AN ADVANTAGEOUS SUBSTITUTE FOR PAINTING IN DISTEMPER. BY M. CARBONELL.

FROM THE BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

IT is well known that a disagreeable smell is perceived on entering apartments newly painted in distemper; therefore till such apartments have been for some time exposed to the contact of the air, no one likes to inhabit them. The following process remedies these two inconveniencies.

The method of operation is very simple; it consists in substituting the serum of beef-blood instead of size, which is usually employed to dilute the colouring matter.

1. The butcher must be requested to catch the blood of one or more oxen in clean vessels. When the blood is become quite cold, that is, in about three or four hours after it has been drawn, the vessels are gently inclined, and by these means a transparent liquid is poured off, which has a slight smell of amber. It is strained through a piece of linen, to separate from it the particles of blood that may be detached and mixed with it.

2. Some quick lime, upon which has been thrown a very small quantity of water only, for the purpose of diminishing the adhesion of its integral parts, must be reduced to powder. This powder is sifted, and it is instantly put away in boxes or bottles, very carefully closed.

3. When the two above mentioned materials are to be used, the serum must be poured into a wooden or earthen vessel, and a sufficient quantity of the pulverized lime added, to give the mixture such a degree of liquidity as to be easily spread with the brush over the surfaces that are to be covered with it.

4. Too great a quantity of this paint must not be prepared at once, for it very quickly becomes thick; and when it has too much consistence it cannot be used. This inconvenience is prevented by keeping it always at the same degree of fluidity, by the addition of a sufficient quantity of serum, which should constantly be

kept near the vessel with the paint, to be used as occasion requires.

5. The colour when in this state should be laid on as speedily as possible.

6. As the colour resulting from the application of this preparation is always white, and one may sometimes wish to have a different colour, it is produced by ochreous earths of the red, yellow, black, or green kinds. A beautiful blue colour may likewise be obtained by employing blue glass, made with the oxyd of cobalt, provided the glass be reduced to an impalpable powder.

7. As the addition of coloured ochreous materials must necessarily weaken the composition, it may be kept at the same degree of solidity by adding a few whites of egg to the serum employed for diluting the composition; but care must be taken not to add too large a quantity, otherwise the paint would be liable to scale off.

8. This kind of paint can only be applied on wood or plaster, which have not been previously covered with oil paint.

9. As a single coat is not sufficient, two or three may be laid on when the work is required to be performed correctly; but before a fresh coat is given the former must be perfectly dry.

10. This paint is capable of taking a beautiful polish by friction, like any other kind; but it is preferable to dip the cloth, with which it is rubbed, in spermaceti rather than any other kind of oil.

11. For diluting white or coloured paint, only fresh serum, which has undergone no alteration, must be employed; otherwise the paint would be of a worse quality and less permanent.

Many precautions are necessary, particularly in summer, for keeping the serum, because this fluid is very strongly disposed to putridity. It is therefore essential to keep it in a cool place, and to examine, before it is employed, whether it does not begin to smell disagreeably; for, in that case, it must not be used.

For the same reason care must be taken to keep the vessels clean in which the serum is preserved, and to wash them often with warm water, to remove the altered particles of the fluid with which the sides of the vessel may be impregnated.

M. Carbonell asserts, that this paint is permanent when prepared with good materials; it may even be employed for painting damp walls without fear of its being detached, an advantage which painting in distemper certainly does not possess.

The same author likewise declares, that he has made numerous experiments with this same paint, and has always obtained such constant and satisfactory results, that he doubts not when it is known, that it will be generally adopted. He mentions amongst others, the use he has made of it, at Barcelona, both in the interiour and exteriour of houses, and he has invariably remarked, that it not only remained unaltered by the sun, the air, humidity, and dryness, but that it was also exempt from any disagreeable smell; so that places painted with it might be inhabited on the very day of applying it.

At first sight one would be led to imagine, that the new kind of paint proposed by M. Carbonell is almost the same thing as the milk-paint described by M. Cadet de Vaux. The latter may have answered, but when we reflect on the material difference that exists between the composition of the serum of blood and that of milk, we shall instantly perceive the superiority of M. Carbonell's paint to the other.

For the rest, experience must decide the matter; and it is to be presumed that it will not fail to show which of the two methods deserves to be adopted in preference.

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## ON THE MEANS OF PROMOTING

### THE GROWTH OF YOUNG FRUIT TREES, PARTICULARLY IN GRASS LAND. BY THE REV. MR. GERMERSHAUSEN.

FROM THE TRANSACTIONS OF THE ECONOMICAL SOCIETY OF LEIPSIC.

WHEN young trees stand in grass-land, or in gardens where the earth is not dug up every year around them, and freed from weeds, they do not at first increase properly in growth, and will not thrive so well as those which have been planted in cultivated ground. It has been remarked also, in orchards, that the more the ground becomes grassy, and, as it were, converted into turf, the fruit is smaller and not so well tasted. The latter circumstance takes place particularly with regard to plums.

Having planted several young plum trees, I covered the ground, for some years, around the trunks, as far as the roots extended, with flax-shows,* by which means these trees, though in a grass field, increased in a wonderful manner, and far excelled others planted in cultivated ground. As far as the shows reached, the grass and weeds were choaked; and the soil under them was so tender and soft, that no better mould could have been wished for by a florist.

When I observed this, I covered the ground with the same substance, as far as the roots extended, around an old plum tree, which appeared to be in a languishing state, and which stood in a grass field. The consequences were, that it acquired a strong new bark; produced larger and better tasted fruit; and that those young shoots which before grew up around the stem, and which it was every year necessary to destroy, were prevented from sprouting forth, as the covering of flax-shows impeded the free access of air at the bottom of the trunk.

Last year (1793) I transplanted from seed-beds, into the nursery, several fruit trees; the ground around some of which I covered, as above, with flax-shows. Notwithstanding the great heat of the summer, none of those trees where the earth was covered with shows, died or decayed; because the shows prevented the earth under them from being dried by the sun. Of those trees around which the ground was not covered, as before mentioned, the fourth part miscarried; and those that continued alive were far weaker than the former.

The leaves which fall from trees in autumn may also be employed for covering the ground, in like manner: but stones, or logs of wood, must be laid on them, to prevent their being dispersed by the wind. In grass land, a small trench may be made around the roots of the tree, when planted, in order to receive the leaves.

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* Shows are the refuse of flax when it is scutched or hackled.

If flax shows are used, this is not necessary; they lie on the surface of the ground so fast as to resist the force of the most violent storm. The leaves which I have found most effectual, in promoting the growth and fertility of fruit trees, are those of the walnut tree. Whether it is, that, on account of their containing a greater abundance of saline particles, they communicate manure to the ground, which thereby becomes tender under them; or that they attract nitrous particles from the atmosphere; or that, by both these means, they tend to nourish the tree, both above and below.

Those who are desirous of raising tender exotick trees from the seed, in order to accustom them to our climate, may, when they transplant them, employ flax-shows with great advantage. This covering will prevent the frost from making its way to the roots; and rats and mice, on account of the sharp prickly points of the flax-shows, will not be able to shelter themselves under them.

## ON OIL AS A MANURE.

BY C. BALDWIN, ESQ.

FROM HUNTER'S GEORGICAL ESSAYS.

HAVING for many years considered oil as the great pabulum of plants, I was much hurt by the result of some experiments, which state oil as *poison;* and turning this in my thoughts a thousand times over, it at last occurred to me, that though oil, as oil in its *crude* state, might act as a poison, yet it might be so changed as to convey it with great advantage to the soil, and I instantly recollected Dr. Hunter's mode by ashes; it also occurred to me that rape-oil cake was known to be an excellent manure, that no objection had ever been made to it but its expensiveness, and that if it was beneficial to the soil, it could only be so from the quantity of oil contained in it, though that quantity must be very small indeed, considering the process of first grinding the rape seed, and the vast force used to drive out the oil, so that what remains is little more than a *caput mortuum;* yet the cake formed of these very remains is known to be a rich manure.

Think for a moment from how many seeds, plants, shrubs, and trees, we draw oil; from rapeseed, linseed, mustard, fennel, anniseed, juniper, carraways, mint, olives, &c. Thus we evidently draw an immense quantity of oil from the earth, but when and how do we convey any to it? I know of little or no attention paid to this circumstance in our compost dunghills, so that all the oil conveyed to them can only be from animal dung.

Whatever may be the quantity of oil remaining in *each* rape cake, and I believe that no one will state it at half an ounce each, yet it must be remembered that after all it is only a *vegetable* oil; reflecting on this circumstance, and fully persuaded that *animal* oil must be much superiour to it, I directly went to town to inquire the price of whale or train oil, and there I was informed, that it was about two shillings and eight pence per gallon; this I considered as too expensive; but, pursuing my object, I was informed by Mr. Wilfred Reed, oil merchant, in Thames street, that he could supply me with bottoms or foots of oil, and a rich, thick South Sea whale oil, at fourteen pence per gallon. This was the very thing I wished for, and directly ordered sixty gallons, for a five-acre field, and thus went to work. Having a platform or bottom of twenty load of mould, with eight load of dung on it, I carried on three load of light sandy mould, and one load of brick and mortar rubbish, ground fine, and having mixed these well, and made a kind of dish of it, about five feet wide and ten feet long, with a ladle we put over it one half of the oil. It was in August, and the warmth of the sun soon made the thick oil soak into this compost, when it was directly thrown up in a heap, broke down again, and by five or six turnings, well mixed together, and left in a heap two days, when it was spread equally over the whole dung hill; twenty load more of good mould was then carried on, eight load of dung, and the remaining thirty gallons of oil were mixed as before, in sandy mould, and brick and mortar rubbish, and equally spread over, and the whole was covered by trimming the four sides of the dunghill, and throwing it on the top.

Thus the dunghill lay more than two months, when it was cut down by mattocks, carefully broke, well mixed, and turned over. The end of March it was carried on the field, spread, and ploughed in; it lay about a fortnight, was then ploughed again, and, on the 22d of April last, it was drilled with the Rev. Mr. Cooke's most excellent drill; I mean his last, with hoes and scarifiers, which I think much superiour to his former one: the last I think every farmer, who has seen it at work, will consider as incapable of further improvement. The field was drilled with barley, two bushels to the acre; the crop came up in a most even and beautiful manner; every seed was up within forty eight hours of each other; all was ripe at the same time, and, from a couple of months after seed-time to harvest, was rated by all who saw it, and it was seen by many, as a sixty bushel crop.

At harvest, three rows were cut across the field, directly thrashed and measured: one load out of thirteen was also thrashed and measured, and both stated the crop to be sixty bushels, but, to wave all possibility of dispute or doubt, I am content to state the crop at seven quarters per acre.

As to the quality of the barley, I could here cite the opinion of one of the most eminent brewers in London, who saw the crop growing, and declared he would readily give 1000l. to be assured that all the barley crops in the kingdom were of equal burden and weight; five quarters of it have been lately sent to Nethrapps, in Norfolk, as seed barley, under the denomination of fifteen comb barley; and an eminent malster tells me it weighs 220 lb. per sack, or 55 lb. per bushel, Winchester measure.

Among the many gentlemen and farmers who saw the crop on the ground, was the celebrated Mr. Bakewell; he came with three or four others, and, walking down the field, observed the hedge and bank; the bank, upon being touched with a stick, ran down as sand and gravel generally do, and Mr. Bakewell being asked his opinion of the value of the land, if I do not mistake, valued it at eighteen pence per acre, but turning to the crop, and desiring his friends to do so also, he admitted that it seemed as if growing on land of fifteen shillings or twenty shillings per acre.

I must not omit saying that the barley followed oats, upon a lay of six years old, that the land was, as is too common in such cases, much infested with the little red or wire worm, and that the oats suffered much from them; when we were ploughing for the barley the first time, I observed many turned up by the plough, when a distant ray of hope instantly darted upon my mind, that the oil in its then state, or from its strong effluvium, might prove obnoxious to them, and I am happy in saying, that the barley did not suffer from them in the least.

I can, however, add here, that I am now trying that experiment in Hampshire, having last autumn made up a dunghill, with twenty gallons of oil, on one-third of it, for a six acre field, which is now drilled with pease.

It is well known that all animal substances, in a state of corruption, wonderfully promote vegetation, and are the actual food of plants.

The whale oil which I used is an animal substance, perhaps the richest part of the animal; whether I used enough, or what is the proper quantity per acre, experience must point out. Say I used eight loads of mould, three or four loads of dung, and twelve gallons of whale oil, *per* acre.

That oil applied to land, as a food for plants, in its crude state, acts as a poison, I cannot deny; but my process is very different; I believe that oil, particularly animal oil, is the pabulum of plants, that is, oil subtilized by the salts in a compost dunghill, left there a considerable time, in a state of putrefaction, and until the whole is become putrescent, *then*, I say, I *believe* I have got the best and richest manure that can be carried on land.

The barley evidently proved its excellence; a ridge of summer cucumbers, in my garden, pointed out to many its great power, the leaves being in general from ten to ten and a half inches broad, and the vines occupied an uncommon space of ground. Five hundred cabbages and savoys, planted by the side of four thousand more, and which had only one handful of the oil manure put into each hole made by the dibble, at the time of planting, were evidently near as big again as the others.

## SPECIFICATION

OF THE PATENT GRANTED TO BENJAMIN HADEN, OF THE PARISH OF SEDGLEY, IN THE COUNTY OF STAFFORD, BAGGING-WEAVER; FOR AN IMPROVEMENT IN THE MANUFACTURE OF BAGGING FOR PACKING OF NAILS, AND OTHER PURPOSES. DATED FEBRUARY 28, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Benjamin Haden do hereby declare, that my said invention of an improvement in the manufacture of bagging for packing of nails, and other purposes, is described in manner following; that is to say: I take for my warp, hurds, or tow, prepared in the usual way, such as are at present used in making nail bagging, but for my weft or woofs I take old ropes, or junk, of any dimensions; and after untwisting or dividing the threads or filaments thereof, I wind the same into bobbins or quills, and they then become fit for the shuttle, and I weave them along with the common warp in the common way. I do not confine my invention to bagging for nails, but the same may be used with advantage for bagging for coals, cokes, and for various other purposes, where strength and durability are required, needless to be mentioned here. In witness whereof, &c.

## OBSERVATIONS BY THE PATENTEE.

I wish it to be known to those persons who are in the habit of using bagging for which my invention is calculated, that the materials I have described in my specification are peculiarly adapted to give strength and durability to that article. The yarn of which ropes are generally made, particularly king's ropes, is spun from the choicest hemp, and strongly impregnated with tar. The threads taken from the middle of such ropes, not having been exposed either to the weather or to friction, are as sound and as strong as when originally used; and, if not quite equal to new, can be but little inferiour. The tarry matter with which these threads are impregnated, renders them peculiarly advantageous in the manufacturing of coal-sacks; the weft being composed of these threads, fine spun, good and strong, adhere firmly to the warp made from hemp in the original way. Sacks made of this cloth are strong, tenacious, and not liable to rent or perish by wet, to which those in present use are particularly subject. The superiority of this invention for nail bagging is very conspicuous: the weft of those now used is made from the coarsest refuse of flax or hemp that can be procured. The consequence of which is, that the bags frequently perish and burst in carriage, to the great loss of those concerned.

## FURTHER OBSERVATIONS

RESPECTING THE BEST MANNER OF PLANTING POTATOES. BY MR. JOSEPH WIMPEY, OF BRATON-CLOVELLY, NEAR OKEHAMPTOM, DEVON.

FROM THE LETTERS AND PAPERS OF THE BATH AND WEST OF ENGLAND SOCIETY FOR THE ENCOURAGEMENT OF AGRICULTURE, &c.

I FORMERLY gave an account of an experiment made to discover whether whole potatoes or cuttings are to be preferred in planting.*

From that account it clearly appeared, that the advantage lay greatly on the side of cuttings. But as, from long experience, I know conclusions drawn from single experiments cannot be safely depended on, and as the result of that experiment differed so widely from an account given by a very respectable correspondent of the society, whose accuracy is well known, and of whose probity and veracity I have the highest opinion, I resolved to repeat my former experiment as exactly as possible, by way of establishing a fact so interesting to the publick, if found just, or of retracting an errour, if it should appear to be one.

In the spring of 1791, I prepared about three acres of ground, and in April planted it with potatoes. A certain quantity of the largest and finest were selected, one half of which were planted whole, the other cut into pieces of a moderate size. An exact account of each

* For Mr. Wimpey's former observations on planting potatoes, see page 152.

was kept at taking up, when it appeared that the produce *per* acre was much the same as in the former experiment; but, as the cut potatoes planted nearly four times the ground that the whole sets did, the advantage lay, in the same proportion, on the side of planting with cut potatoes; therefore I think there cannot be the least doubt that the preference is to be given to cuttings, as the success of the two experiments so nearly coincides.

I have been used for some years to furnish my neighbours with potatoes for planting. The last season, one of them desired I would let him have them all small. He said he had planted small ones several years, that he found them equally productive with the largest, and saved much trouble in cutting. Others (who carried their economy much farther) preferred the largest; they, it seems, used to pare them, to eat the fleshy part, and to plant the rinds only. Upon inquiry, I found this was not an unusual practice among the cottagers; and, I have been credibly informed that they get as large crops, and as good potatoes, in that method of planting as in any other whatever. If this be a fact, it seems to appear, that the fleshy part of the bulb is of no use in supplying nourishment to the young fruit, after the fibrous roots have put forth, and laid hold of the ground. Perhaps an experiment of this sort may be thought worth making.

## REMARKS BY T. G. F.

The observations and experiments of Mr. Wimpey contradict the generally received opinions of American agriculturists; who, I believe, generally suppose it to be good economy to reserve the largest potatoes for planting. It is thought by many that large potatoes when planted, supply, by their decay, pabulum to the young plants. It, however, often happens that sound potatoes of some kinds, when planted without cutting, decay but little, previous to digging the new crop; and as it cannot be supposed that they furnish food for the young plants without having undergone the putrefactive process, the latter will derive no benefit from the original potatoe. It is probable, however, if a large potatoe were cut into slips, in order to facilitate putrefaction, *and the slips all planted*, the produce would *cæteris paribus* be greater than if the potatoe were planted whole.

## MR. CHARLES FREDERICK MOLLERSTEN'S

### PATENT FOR A COMPOSITION TO RENDER LEATHER, WOOLLEN CLOTH, LINEN, AND OTHER STUFFS WATER PROOF, IMPENETRABLE TO HOT AND CORRODING LIQUORS, &c. GIVING THEM A FINE GLOSS, PRESERVING THEM FROM DECAY, AND KEEPING THEM SOFT AND PLIABLE. DATED JAN. 1805.

TO prepare the composition of a black colour, Mr. Mollersten gives the following directions:

"Take two gallons of linseed oil, one gallon of whale oil, half a pound of horse grease, mingle them with four pounds of finely ground Prussian blue, and four pounds of lamp black, and afterwards boil them over a strong fire; to which add one pound of fine ground benzoin gum, previously well mingled in one gallon of linseed oil, of which one half gallon is to be put in the above. when the composition has boiled half an hour, and the remainder when the boiling is finished. This composition is sufficiently boiled when it gets so thick *that no drops fall from any thing dipped into it;* and it is afterwards fit for use when cold.

"For making the composition of other colours. The genuine linseed oil must be well bleached: to two gallons of which put half a gallon of spermaceti oil, and half a pound of Prussian blue, place them in a glass vessel in a strong sun (the effect may be increased by burning glasses if necessary) and when they have attained the same consistency as the black composition, after having boiled one half hour, take one pound of benzoin gum mixed with one gallon of linseed oil bleached, add one half of it to them and place the same in the sun, as before; and, when it has again attained the same consistency as the black composition, add the remaining half of the gum and oil."

Mr. Mollersten recommends that the colours used should be at least one half of metallick compositions, as he is not certain that colours composed of animal substances only will answer the purpose: he also observes, that the Prussian blue mixed with the other colours renders the substances on which they are put *capable of resisting hot and corrosive liquors*, though without it they will resist wet equally well.

Mr. Mollersten directs the composition to be laid very thin at first, on the substances to which it is to be applied, and that *scraping irons* be used for this purpose.

The substances are then to be stretched on a board or frame over blanketing, and put into an oven to dry the composition, and this operation is to be repeated till the substances have attained the proper gloss and smoothness; besides the scrapers, pumice stone is to be used in the intervals of drying, to make the surfaces smooth and even: from four to six repetitions of the lackering and drying will generally complete the process.

OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

ONE of the directions for boiling the composition should not be followed too exactly, or the whole composition will probably be spoiled, that is, "*to boil it till no drops fall from any thing dipped into it;*" this is one of those extremely vague rules which those who are well acquainted with a process frequently give, from not considering that those they desire to instruct are not sufficiently acquainted with such operations to know that they mean by such phrases any thing but the literal sense. The direction would probably be nearer the truth if it was, that the matter should be boiled till it adhered to any thing dipped into it; or till the whole of the matter adhering to any thing dipped into it did not again fall off in drops.

## MR. BELL'S PATENT

FOR MAKING MOULDS TO MANUFACTURE KNIFE, RAZOR, AND SCISSOR BLADES, VARIOUS EDGE TOOLS, FORKS, FILES, AND NAILS. DATED MARCH, 1805.

THE moulds mentioned in the title of this patent consist of certain impressions cut into steel or cast iron rollers; which rollers are fixed so to correspond with other rollers, that a heated bar of metal passed between them shall assume the intended shape by being forced into the cavities of the rollers, by their motion round.

Mr. Bell very properly states that the object of his patent is the peculiar figures or impressions cut on the faces of his rollers; for the invention of forming articles into particular shapes by passing them under figured rollers can claim no novelty, and any merit of it will have to be divided with several other patentees.

For the description of his rollers, Mr. Bell refers principally to the figures in his drawings; one of them viewed endways presents the figure of a serrated (or ratchet) wheel. It is easy to conceive that a flat bar, will, by being passed under this roller with a due compression, be formed into a number of oblong pieces, thick at the back, and gradually tapering to the edge.

Another roller is cut the reverse way of this first, its cavities continue all round, and form a number of circular grooves, deep at one side, and gradually sloping upwards to the surface; a flat bar rolled under this roller will be also formed into a number of pieces, of the same shape as the others before mentioned, but of a much greater length, and by it may also be shaped into lengths sloping from the upper extremity towards the point, as well as from the back to the edge, by having the circular cavaties cut less deep at one side of the roller than another, and gradually sloping round from the deepest part to the shallowest.

The rollers described are the only ones of which drawings are given; the figures on the surfaces of the others wanted, may easily be imagined from these.

Mr. Bell declares his principal object is to manufacture copper sprigs, or nails, by these rollers, previous to heading.

# METHOD

## OF PRESERVING YOUNG PLANTATIONS OF TREES FROM BEING INJURED BY HARES OR RABBITS.—BY WILLIAM PATTENSON, ESQ. OF IBORDEN, KENT.

FROM THE TRANSACTIONS OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, &c.

HARES, rabbits, and rats, have a natural antipathy to tar; but tar, though fluid, contracts (when exposed to the sun and air for some time) a great dryness, and a very binding quality; and, if applied to trees in its natural state, will occasion them to be bark bound.

To remove this difficulty, tar is of so strong a savour, that a small quantity, mixed with other things, in their nature loose and open, will give the whole mixture such a degree of its own taste and smell, as will prevent hares, &c. from touching what it is applied to.

Take any quantity of tar, and six or seven times as much grease, stirring and mixing them well together; with this composition brush the stems of young trees, as high as hares, &c. reach, and it will effectually prevent their being barked. I believe, if a plantation of ash (which they are very fond of) were made in a rabbit-warren, this mixture would certainly preserve it. These animals do great mischief amongst flowering shrubs, and are particularly fond of Spanish broom, Scorpion senna, and evergreen Cytisus. I have had those shrubs eaten down to a stump; but, as the mixture cannot be conveniently applied to them, I have enclosed their branches with new tar twine, putting it several times round the shrub, which has had the desired effect. Tar twine, by being exposed to the air and rain, will lose its smell, consequently must be renewed as occasion requires; but the mixture is always to be preferred, where it can be used.

## REMARK BY T. G. F.

It is probable that the abovementioned composition would preserve young trees in nurseries from the depredations of the field mouse, which are often fatal to young fruit trees in many parts of the United States.

## THE BEST MODE OF TAKING HONEY.

FROM THE LITERARY MAGAZINE.

THE following easy method of taking honey, without destroying the bees, is the method generally adopted throughout France. In the dusk of the evening, when the bees are quietly lodged, approach the hive and turn it very gently over; having steadily placed it in a small pit previously dug to receive it, with its bottom uppermost, cover it with a clean new hive, which has been previously prepared, with two small sticks stuck across its middle, and rubbed with some aromatick herbs. Having carefully adjusted the mouth of each hive to the other, so that no aperture remains between them, take a small stick, and beat gently round the sides of the lower hive for ten minutes or a quarter of an hour, in which time the bees will leave their cells in the lower hive, ascend and adhere to the upper one. Then gently lift the new hive, with all its tenants, and place it on the stand from whence the other hive was taken. This should be done some time in the week preceding midsummer day: that the bees may have time, before the summer flowers are faded, to lay in a new stock of honey, which they will not fail to do, for their subsistence through the winter. As many as have the humanity and good sense to adopt this practice, will find their reward in the increase of their stock, and their valuable produce.

## DESCRIPTION

### OF A SUB-MARINE VESSEL OR DIVING MACHINE, INVENTED BY MR. D. BUSHNELL, OF CONNECTICUT.

FROM THE TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE external shape of the sub-marine vessel bore some resemblance to two upper tortoise shells of equal size, joined together; the place of entrance into the vessel being represented by the opening made by the swell of the shells, at the head of the animal. The inside was capable of containing the operator, and air sufficient to support him thirty minutes without receiving fresh air. At the bottom, opposite to the entrance, was fixed a quantity of lead for ballast. At one edge, which was directly before the operator, who sat upright, was an oar for rowing forward or backward. At the other edge was a rudder for steering. An aperture, at the bottom, with its valve, was designed to admit water, for the purpose of descending; and two brass forcing pumps served to eject the water within, when necessary for ascending or descending, or continuing at any particular depth.—A water gauge or barometer determined the depth of the descent, a compass directed the course, and a ventilator within supplied the vessel with fresh air, when on the surface.

The entrance into the vessel was elliptical, and so small as barely to admit a person. This entrance was surrounded with a small elliptical iron band, the lower edge of which was let into the wood of which the body of the vessel was made, in such a manner, as to give its utmost support to the body of the vessel against the pressure of the water. Above the upper edge of this iron band there was a brass crown, or cover, resembling a hat with its crown and brim, which shut water tight upon the iron band: the crown was hung to the iron band with hinges, so as to turn over sidewise, when opened. To make it perfectly secure when shut, it might be screwed down upon the band by the operator, or by a person without.

There were in the brass crown three round doors, one directly in front, and one on each side, large enough to put the hand through—when open they admitted fresh air; their shutters were ground perfectly tight into their places with emery, hung with hinges, and secured in their places when shut. There were likewise several small glass windows in the crown, for looking through, and for admitting light in the day time, with covers to secure them. There were two air pipes in the crown. A ventilator within drew fresh air through one of the air pipes, and discharged it into the lower part of the vessel; the fresh air introduced by the ventilator expelled the impure light air through the other air pipe. Both air pipes were so constructed, that they shut themselves whenever the water rose near their tops. so that no water could enter through them, and opened themselves immediately after they rose above the water.

The vessel was chiefly ballasted with lead fixed to its bottom; when this was not sufficient, a quantity was placed within, more or less, according to the weight of the operator; its ballast made it so stiff, that there was no danger of oversetting. The vessel with all its appendages, and the operator, was of sufficient weight to settle it very low in the water. About two hundred pounds of the lead, at the bottom for ballast, would be let down forty or fifty feet below the vessel; this enabled the operator to rise instantly to the surface of the water, in case of accident.

When the operator would descend, he placed his foot upon the top of the brass valve, depressing it, by which he opened a large aperture in the bottom of the vessel, through which the water entered at his pleasure; when he had admitted a sufficient quantity, he descended very gradually; if he admitted too much, he ejected as much as was necessary to obtain an equilibrium, by the two brass forcing pumps, which were placed at each hand. Whenever the vessel leaked, or he would ascend to the surface, he also made use of these forcing pumps. When the skilful operator had obtained an equilibrium, he could row upward or downward, or continue at any particular depth, with an oar, placed near the top of the vessel, formed upon the principle of the screw, the axis of the oar entering the vessel; by turning the oar one way he raised the vessel, by turning it the other way he depressed it.

A glass tube eighteen inches long, and one inch diameter, standing upright, its upper end closed, and its lower end, which was open, screwed into a brass pipe, through which the external water had a passage into the glass tube, served as a water-gauge or barometer. There was a piece of cork, with phosporus on it, put into the water gauge. When the vessel descended the water rose in the water-gauge, condensing the air within, and bearing the cork, with its phosphorus, on its surface. By the light of the phosphorus, the ascent of the water in the gauge was rendered visible, and the depth of the vessel under water ascertained by a graduated line.

An oar, formed upon the principle of the screw, was fixed in the fore part of the vessel; its axis entered the vessel, and being turned one way, rowed the vessel forward, but being turned the other way rowed it backward; it was made to be turned by the hand or foot.

A rudder, hung to the hinder part of the vessel, commanded it with the greatest ease. The rudder was made very elastick, and might be used for rowing forward. Its tiller was within the vessel, at the operator's right hand, fixed, at a right angle, on an iron rod, which passed through the side of the vessel; the rod had a crank on its outside end, which commanded the rudder, by means of a rod extending from the end of the crank to a kind of tiller, fixed upon the left hand of the rudder. Raising and depressing the first mentioned tiller turned the rudder as the case required.

A compass marked with phosphorus directed the course, both above and under the water; and a line and lead sounded the depth when necessary.

The internal shape of the vessel, in every possible section of it, verged towards an ellipsis, as near as the design would allow, but every horizontal section, although elliptical, yet as near to a circle as could be admitted. The body of the vessel was made exceedingly strong; and to strengthen it as much as possible, a firm piece of wood was framed, parallel to the conjugate diameter, to prevent the sides from yielding to the great pressure of the incumbent water, in a deep immersion. This piece of wood was also a seat for the operator.

Every opening was well secured. The pumps had two sets of valves. The aperture at the bottom, for admitting water, was covered with a plate perforated full of holes to receive the water, and prevent any thing from choaking the passage, or stopping the valve from shutting. The brass valve might likewise be forced into its place with a screw, if necesary. The air pipes had a kind of hollow sphere, fixed round the top of each, to secure the air-pipe valves from injury: these hollow spheres were perforated full of holes, for the passage of the air through the pipes: within the air pipes were shutters to secure them, should any accident happen to the pipes, or the valves on their tops.

Wherever the external apparatus passed through the body of the vessel, the joints were round, and formed by brass pipes, which were driven into the wood of the vessel, the holes through the pipes were very exactly made, and the iron rods, which passed through them were turned in a lathe to fit them; the joints were also kept full of oil, to prevent rust and leaking. Particular attention was given to bring every part, necessary for performing the operations, both within and without the vessel, before the operator, and as conveniently as could be devised; so that every thing might be found in the dark, except the water-guage and the compass, which were visible by the light of the phosphorus, and nothing required the operator to turn to the right hand or to the left, to perform any thing necessary.

## DESCRIPTION OF A MAGAZINE, AND ITS APPENDAGES, DESIGNED TO BE CONVEYED BY THE SUB-MARINE VESSEL TO THE BOTTOM OF A SHIP.

In the fore part of the brim of the crown of the sub-marine vessel, was a socket, and an iron tube, passing through the socket; the tube stood upright, and could slide up and down in the socket, six inches: at the top of the tube was a wood screw, fixed by means of a rod, which passed through the tube, and screwed the wood-screw fast upon the top of the tube. By pushing the wood-screw up against the bottom of a ship, and turning it at the same time, it would enter the planks; driving would also answer the same purpose; when the wood-screw was firmly fixed, it could be cast off by unscrewing the rod, which fastened it upon the top of the tube.

Behind the sub-marine vessel was a place, above the rudder, for carrying a large powder magazine; this was made of two pieces of oak timber, large enough, when hollowed out, to contain one hundred and fifty pounds of powder, with the apparatus used in firing it, and was secured in its place by a screw, turned by the operator. A strong piece of rope extended from the magazine to the wood-screw above mentioned, and was fastened to both. When the wood-screw was fixed, and to be cast off from its tube, the magazine was to be cast off likewise by unscrewing it, leaving it hanging to the wood-screw: it was lighter than the water, that it might rise up against the object, to which the wood-screw and itself were fastened.

Within the magazine was an apparatus, constructed to run any proposed length of time, under twelve hours; when it had run out its time, it unpinioned a strong lock resembling a gun lock, which gave fire to the powder. This apparatus was so pinioned, that it could not possibly move, till, by casting off the magazine from the vessel, it was set in motion.

The skilful operator could swim so low on the surface of the water, as to approach very near a ship in the night, without fear of being discovered, and might, if he chose, approach the stem or stern above water, with very little danger. He could sink very quickly, keep at any depth he pleased, and row a great distance in any direction he desired, without coming to the surface, and when he rose to the surface, he could soon obtain a fresh supply of air, when, if necessary, he might descend again, and pursue his course.

## EXPERIMENTS MADE TO PROVE THE NATURE AND USE OF A SUB-MARINE VESSEL.

The first experiment I made was with about two ounces of gunpowder, which I exploded four feet under water, to prove to some of the first personages in Connecticut that powder would take fire under water.

The second experiment was made with two pounds of powder enclosed in a wooden bottle, and fixed under a hogshead, with a two inch oak plank between the hogshead and the powder; the hogshead was loaded with stones as deep as it could swim; a wooden pipe descending through the lower head of the hogshead, and through the plank, into the powder contained in the bottle, was primed with powder. A match put to the priming, exploded the powder, which produced a very great effect, rending the plank into pieces; demolishing the hogshead; and casting the stones and the ruins of the hogshead, with a body of water, many feet into the air, to the astonishment of the spectators. This experiment was likewise made for the satisfaction of the gentlemen above mentioned.

I afterwards made many experiments of a similar nature, some of them with large quantities of powder; they all produced very violent explosions, much more than sufficient for any purpose I had in view.

In the first essays with the sub-marine vessel I took care to prove its strength to sustain the great pressure of the incumbent water when sunk deep, before I trusted any person to descend much below the surface: and I never suffered any person to go under water without having a strong piece of rigging made fast to it, until I I found him well acquainted with the operations necessary for his safety. After that I made him descend and continue at particular depths, without rising or sinking, row by the compass, approach a vessel, go under her, and fix the *wood-screw* mentioned before, into her bottom, &c. until I thought him sufficiently expert to put my design into execution.

I found, agreeably to my expectations, that it required many trials to make a person of common ingenuity a skilful operator. The first I employed was very ingenious, and made himself master of the business, but was taken sick in the campaign of 1776, at New York, before he had an opportunity to make use of his skill, and never recovered his health sufficiently afterwards.

## EXPERIMENTS MADE WITH A SUB-MARINE VESSEL.

After various attempts to find an operator to my wish, I sent one, who appeared more expert than the rest, from New York, to a fifty gun ship, lying not far from Governour's island. He went under the ship, and attempted to fix the wood screw into her bottom, but struck, as he supposes, a bar of iron, which passes from the rudder hinge, and is spiked under the ship's quarter. Had he moved a few inches, which he might have done, without rowing, I have no doubt but he would have found wood where he might have fixed the screw; or, if the ship were sheathed with copper, he might easily have pierced it: but not being well skilled in the management of the vessel, in attempting to move to another place, he lost the ship; after seeking her in vain, for some time, he rowed some distance, and rose to the surface of the water, but found daylight had advanced so far, that he durst not renew the attempt. He says that he could easily have fastened the magazine under the stem of the ship, above water, as he rowed up to the stern, and touched it before he descended. Had he fastened it there, the explosion of one hundred and fifty pounds of powder, (the quantity contained in the magazine,) must have been fatal to the ship. In his return from the ship to New York, he passed near Governour's Island, and thought he was discovered by the enemy on the island; being in haste to avoid the danger he feared, he cast off the magazine, as he imagined it retarded him in the swell, which was very considerable. After the magazine had been cast off one hour, the time the internal apparatus was set to run, it blew up with great violence.

Afterwards, there were two attempts made in Hudson's river, above the city, but they effected nothing. One of them was by the aforementioned person. In going towards the ship, he lost sight of her, and went a great distance beyond her: when he at length found her, the tide ran so strong, that, as he descended under water, for the ship's bottom, it swept him away. Soon after this the enemy went up the river, and pursued the boat which had the sub-marine vessel on board, and sunk it with their shot. Though I afterwards recovered the vessel, I found it impossible, at that time, to prosecute the design any further. I had been in a bad state of health, from the beginning of my undertaking, and was now very unwell; the situation of publick affairs was such, that I despaired of obtaining the publick attention, and the assistance necessary. I was unable to support myself, and the persons I must have employed, had I proceeded. Besides, I found it absolutely necessary, that the operators should acquire more skill in the management of the vessel, before I could expect success; which would have taken up some time, and made no small additional expense. I therefore gave over the pursuit for that time, and waited for a more favourable opportunity, which never arrived.

## OTHER EXPERIMENTS MADE WITH A DESIGN TO FIRE SHIPPING.

In the year 1777, I made an attempt from a whale boat against the Cerberus frigate, then lying at anchor between Connecticut river and New London, by drawing a machine against her side, by means of a line. The machine was loaded with powder, to be exploded by a gun lock, which was to be unpinioned by an apparatus, to be turned by being brought along-side of the frigate. The machine fell in with a schooner at anchor, astern of the frigate, and concealed from my sight. By some means or other it was fired, and demolished the schooner and three men—and blew the only one left alive overboard, who was taken up very much hurt.

After this I fixed several kegs under water, charged with powder, to explode, upon touching any thing, as they floated along with the tide. I set them afloat in the Delaware, above the English shipping at Philadelphia, in December, 1777. I was unacquainted with the river, and obliged to depend upon a gentleman very imperfectly acquainted with that part of it, as I afterwards found. We went as near the shipping as he durst venture. I believe the darkness of the night greatly deceived him, as it did me. We set them adrift to fall by the ebb, upon the shipping. Had we been within sixty rods I believe they must have fallen in with them immediately, as I designed; but, as I afterwards found, they were set adrift much too far distant, and did not arrive until after being detained some time by frost, they advanced in the day time, in a dispersed situation, and under great disadvantages. One of them blew up a boat with several persons in it, who imprudently handled it too freely, and thus gave the British that alarm which brought on *the battle of the Kegs.*

## SUBSTANCE

### OF A SPECIFICATION OF A PATENT GRANTED TO DENNIS M'CARTHY, OF ROMNEY ROW, WESTMINSTER, ESQUIRE; FOR HIS NEW INVENTED COMPOUND FOR COVERING HOUSES, AND FOR OTHER PURPOSES.

TAKE three bushels of any white fluxing sand; mix it with one bushel of salt; calcine it in a furnace, till it becomes a hard substance, pound or grind it fine, and take of the powder one bushel; add one bushel of whiting, or white clay, (or whiting and clay, of each one half,) and one bushel of calcined ground flint; or ground glass may be substituted for the articles first abovementioned (salt and sand) and white silver sand for flints; or plaster of Paris may be mixed with the clay. The compound may be made of a beautiful pearl or slate colour by putting into it a proper quantity of smalt. When this compound is mixed, moisten it with water, and work it well together, either with the feet, shovel, or plasterer's beaters, till of a proper consistency to form into moulds; then press it in the moulds, shaped as fancy may direct, and when dry burn them in a kiln, as you burn potter's ware. The size should be according to the distance of the rafters; and so placed that the joints may meet in the centre of the rafters, and either over a close made joint, or be made to fit in each other, in a ribbet; and these are to be fastened to the rafters by pegs or screws, nails, or any other fastening, and the joints should be closed with stone cement, tarras, or fine mortar.

# ON PRESERVING SEEDS

## IN A STATE FIT FOR VEGETATION.—BY JOHN SNEYD, ESQ. OF BELMONT, STAFFORDSHIRE.

FROM THE TRANSACTIONS OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, &c.

MANY years ago, having observed some seeds which had got accidentally amongst raisins, and that they were such as were generally attended with difficulty to raise in England, after coming, in the *usual way*, from abroad, I sowed them in pots, within a framing; and, as all of them grew, I commissioned my sons, who were then abroad, to pack up all sorts of seeds they could procure, in absorbent paper, and send some of them surrounded by raisins, and others by brown moist sugar, concluding, that the former seeds had been preserved, by a *peculiarly favourable state of moisture* thus afforded them. It occurred, likewise, that as many of our common seeds, such as clover, charlock, &c. would lie dormant for years within the earth well preserved for vegetation, whenever they might happen to be thrown to the surface, and exposed to the atmosphere, so these foreign seeds might be equally preserved, *for many months at least*, by the kindly covering, and genial moisture, that either raisins or sugar afforded them. This conjecture was really fulfilled; as not one in twenty of them failed to vegetate, when those of the *same kinds*, that I ordered to be sent lapped in common parcels, and forwarded with them, would not grow at all.

I observed, upon examining them all, before they were committed to the earth, that there was a prevailing dryness in the latter, and that the former looked fresh and healthy, and were not in the least infested by insects, as was the case with the others.

It has been tried, repeatedly, to convey seeds (of many plants difficult to raise) closed up in bottles, but without success; some greater proportion of air, as well as a proper state of moisture, being perhaps necessary.

I should observe, that no difference was made in the package of the seeds, respecting their being kept in husks, pods, &c. so as to give those in raisins or sugar any advantage over the others: all being sent equally guarded by their natural teguments. Whether any experiments of this nature have been made by others, I am totally ignorant; but I think that, should this mode of conveyance be pursued still more satisfactorily than I have done, very considerable advantages might result from it.

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## DESCRIPTION OF A LIQUOR

### FOR DISCOVERING, IN WINES, THE PRESENCE OF SUCH METALS AS ARE INJURIOUS TO HEALTH.—BY DR. HAHNEMAN.

FROM THE JOURNAL DE PHYSIQUE.

THE property which liver of sulphur and hepatick air possess, of precipitating lead of a black colour, has long been known, and this property has been made use of in the preparation of a liquor called *Liquor probatorius Wurtemburgicus*, by which it was supposed the purity of wines might be ascertained.

But, in examining wines which are suspected to be adulterated, this liquor can by no means be trusted to, because it precipitates iron of the same colour as it does lead, which is so poisonous a metal. For this reason, many respectable wine merchants have been thought guilty of adulterating their wines, to the great injury of their character.

Consequently there was still wanting a test or re-agent that should point out, in wines, the presence of such metals only as are injurious to health. This property the following liquor possesses, as it precipitates lead and copper of a black colour, arsenick of an orange colour, &c. It does not, however, precipitate iron, which frequently, by various means, gets unobserved into wines, but which is generally harmless, and in many cases salutary, to the human frame.

### PREPARATION OF THE NEW PROBATORY LIQUOR.

MIX together equal parts of oyster shells and crude brimstone, both finely powdered: put the mixture into a crucible, and place the crucible in a wind furnace. When it is heated, let the fire be suddenly increased, till the crucible becomes of a white heat, in which state it is to be continued for about a quarter of an hour. The mass, when cold, is to be reduced to powder, and kept in a bottle closely stopped.

In order to prepare the liquor, one hundred and twenty grains of the above powder, and one hundred and eighty grains of cream of tartar, are to be put into a very strong bottle, which is to be filled up with common water, that has been previously boiled for about an hour and then suffered to cool. The bottle must be immediately corked, and afterwards shaken from time to time. When it has remained still for a few hours, the clear liquor must be decanted into small phials, capable of holding one ounce, into each of which, twenty drops of spirit of sea-salt have been previously dropped. The mouths of the phials must then be well closed with stopples, composed of wax mixed with a small quantity of turpentine.

If one part of the above liquor be mixed with three parts of the wine meant to be examined, the slightest impregnation of lead, copper, &c. will be immediately discovered, by a very perceptible black precipitate. But, if the wine contains iron, the liquor will have no effect upon that metal.

When the above precipitate has subsided to the bottom, we may find out whether the wine contains any iron, by decanting the clear liquor, and adding to it a little salt of tartar; if there is any iron in the wine the liquor will immediately turn black.

Wines which are pure and unadulterated, remain clear after the addition of this liquor.

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## DESCRIPTION

### OF THE BAVARIAN METHOD OF EVAPORATING SALT WATERS. BY MONSIEUR BONNARD.—BULLETIN DES SCIENCES, NO. 90.

THIS method has been introduced into the salt work of Moyenvie by M. Cleiss, inspector of the salt works of Bavaria.

The pans are formed of plates joined by their edges, which are turned downwards, and consequently without the pan: they are solidly united by a piece in the form of a square gutter, which receives the edges, and is secured by a great number of screws.

The evaporating house contains six pans, disposed in two rows: these pans have different uses, which require a particular arrangement.

That in the middle of the back row is the smallest; it has no particular fireplace, but is heated by the junction of the chimnies from the other fireplaces. The salt water deposits its impurities in it: it is called the small pan.

From the small pan the salt water passes into the graduating pan, which is lower than the first, and placed in the middle of the front row; it is there kept in a state of constant ebullition: the water is concentrated in it 20 degrees, and deposits a part of its sulphurated lime.

From the graduating pan the salt water passes into the preparing pans, which are lower than it, and situated at the two extremities of the back row; there it is also kept constantly boiling: it is completely concentrated, and deposits all its sulphate of lime; it is then passed into the chrystallizing pans, placed still lower than those of preparation, at the two extremities of the front row; there the water scarcely boils, and the salt chrystallizes.

Each pan, except the small one, has a particular fireplace, the chimnies of which pass round the sides of the pan: they unite under the small pan, by which means little heat is lost.

These pans are placed two and two, in chambers of wood, the joinings of which are well secured: these chambers are low, and their ceilings are perforated in the middle with holes terminating in a tube, by means of which the aqueous vapour is disengaged with rapidity. The chambers for the crystallizing pans have their ceilings pyramidal, or in the form of a reversed hopper; while that over the small pan and the graduating pan is flat.

The saline waters are passed successively into these four kinds of pans: the workmen penetrate into the chambers, in the midst of the vapours, to open the communications between the pans. This operation is performed every six hours, and the water in each pan is restored to the level at which it stood six hours before. Every three hours the salt in the crystallizing pans is collected. It is brought with scoops to elevations on the front edge of the crystallizing pans, where it drains; it is afterwards carried into drying rooms, which surround the outside of the chambers: these are spaces covered with iron plates; they are warmed by heat-tubes passing from the fireplaces.

Every eight days they take away the sulphate of lime, throw out the mother waters, and break the shell; that is to say, the incrustations of salt which adhere to the bottoms of the pans: every twenty-four days the work is entirely stopped, to repair the pans, which is performed by the workmen themselves. It has been found that this method of evaporation saves more than one third of the fuel.

An improvement has been made lately in this process at Dieuse: the small pan has been suppressed, and the drying pans have been replaced by auxiliary pans, in which a coarse salt is made.

The heated drying rooms are useless, when the humidity of the salt arises from the muriate of lime which it contains.

## OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

The principal difference of this apparatus from those in common use consists in the preparatory pans, and in the method of uniting the iron plates to form the pans themselves.

By the use of the preparatory pans, the marine salt can be obtained more pure, from its leaving behind in them the earthy salt, with which it is mixed; and much saving will also arise in fuel from this method, obviating the necessity of altering the temparature of the liquor at different parts of the process; in the course of which, parts of the apparatus are cooled in the old way, which must be again heated, but which always remain at the same temparature in the mode of management described.

The method of uniting the iron plates, to form the pans, it is also apprehended will make a much tighter joint than that in use for the same purpose in this country, and less liable to give way: however, it seems that rivets would do as well for fastening the bent edges of the plates as the screws mentioned, and would certainly cost much less; but perhaps the use of the screws may afford a facility to the workmen for the repair of the pans, which may amply pay for their cost. Mr. Manley, near Chester, obtained a patent, in 1801, for a method of making salt, in many respects similar to the above described; for which see Repertory of Arts, vol. xv. First Series.

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## METHOD OF CONNECTING IRON BARS,

AND COATING THEM WITH LEAD, SO AS TO FORM SOLID PILLARS FOR LIGHT HOUSES, ON ROCKS COVERED AT HIGH WATER, WITHOUT BEING SUBJECT TO CORROSION FROM THE ACTION OF SEA WATER. BY CAP. JOS. BRODIE, OF THE ROYAL NAVY.—TRANS. SOC. OF ARTS, VOL. XXII.

IN this method, four square rods of cast iron are composed of a number of pieces two feet long, and so rivetted together, that the ends of the component pieces are uniformly distributed, producing the effect of one bar of double the breadth and thickness of the smaller ones; a hollow tube of cast iron formed from a number of separate pieces, each about 10 inches long, which, when placed round the connected iron bars and screwed together, form a mould, into which melted lead is to be poured, to coat the rods or bars. By these means, the rods may, by small portions at a time, be completely covered with melted lead, so as to form a cylindrical pillar apparently of lead. The hollow cylinder is readily formed to any length required, by the junction of a number of semi-cylinders, fitting each other and rivetted together.

After a certain portion of the iron rods is coated with lead, the lower parts of the tube are taken off and placed higher up, so that a few tubes may answer the purpose of coating any length of the iron rods.

# ON THE USE OF OXYDS OR CALCES

## OF IRON IN DYING COTTON. BY J. A. CHAPTAL.

### FROM THE ANNALES DE CHEMIE.

THE oxide of iron has so strong an affinity to cotton, that if a cotton thread is dipped in a saturated solution of iron, in any kind of acid the thread instantly acquires a buff colour, more or less deep, according to the strength of the liquor. This affinity may be shown by the following experiment, which is both curious and easy to be made. If a skein of cotton thread is dipped into a solution of green vitriol, rendered turbid by the oxide which remains suspended therein, and the cotton is moved about in the liquor, it will take up every particle of the oxide, and thereby restore to the liquor the transparency it had lost; after which, the solution, which at first had a yellowish hue, becomes more or less green, according to its strength.

The colour given to the cotton by the oxide of iron, grows darker merely by the exposure to the air; and this colour, which is soft and pleasant when the cotton is taken from the bath, becomes harsh and ochrey by the progressive oxidation of the metal.

The colour given by the oxide of iron is very permanent; it not only resists air and water; but alkaline lies, or soap, give it brilliancy, without sensibly diminishing its intensity.

On account of these properties, the oxide of iron has become an essential ingredient in the art of dying, being considered as a colouring principle of the utmost value. I have been so fortunate as to extend the use of this oxide; but shall confine myself at present to such results as have been found worthy of a place in the operations of the dier, and have for several years been practised with success in my manufactory.

In order that the oxide of iron may be conveniently applied upon the cotton thread, we must begin by making a solution of the said oxide; for which purpose, acids are the most useful solvents.

In most places, diers make a secret of the acid they employ; but it is always either the aceteus, the vitriolick, the nitrous, or the marine acid.

Some diers pretend there is a great difference in the effect of the different acids, but, in general, they give the preference to the acetous.

This preference appears to me to be founded much less on the difference of colour produced by the different salts, than on the different degree of corrosive power which each salt exerts upon the cotton. The power of the mineral acids is so great, that if the stuff is not washed when taken out of the bath, it will certainly be corroded; whereas, the solutions made in the acetous, or any other vegetable acid, are not attended with this disadvantage.

Iron appears to be as much oxidated by being dissolved in one acid as in the other, since it produces the same shade of colour when precipitated; and any acid may be employed, without distinction, provided the degree to which the acid is saturated, and the nature of the salt formed therewith, are sufficiently known; for the subsequent operations may be regulated by the knowledge of these circumstances, so as to avoid the inconveninences attending the use of some of these salts. This is, in the first instance, an advantage the man of science has over the common workman, who knows not how to vary his process according to the nature and state of the salts he makes use of.

I shall at present only point out what colour may be obtained by means of the oxide of iron; first, when employed by itself, on stuff which has been properly prepared for receiving the Adrianople or Turkey red.

First. If sulphate of iron, or any other martial salt, be dissolved in water, and cotton be dipped in it, it will, as was before said, acquire a buff colour, more or less deep, according to the strength of the solution; and the affinity of the cotton to the iron is so strong, that it attracts the metal, and takes it in great measure from the acid in which it was dissolved.

Secondly. If iron be precipitated from a pretty strong solution, by an alkaline liquor (of five or six degrees, Baumé's areometer) a coagulum of a greenish blue colour will be formed; if cotton be macerated therein, it will immediately acquire an irregular and dirty green colour, which, by mere, exposure to the air, will, in a short time, turn to a very deep yellow colour.

By these processes, or similar ones, diers produce what are called ochre or rust colours.

But these colours are attended with several inconveniences; first, when they are very deep, they corrode or wear the stuff; secondly, this colour is harsh, and does not mix well with the soft colours produced from vegetables.

I endeavoured to remedy these inconveniences, and I succeeded in the following manner.

I soak the cotton in a cold solution of green vitriol (of three degrees of strength) and, having wrung it carefully, I immediately plunge it into a lie of pot-ash (of two degrees) upon which I pour a saturated solution of alum. The colour then grows brighter, and becomes infinitely more fine, more soft, and more pleasant. The vitriol no longer corrodes the substance of the cotton, and, after it has remained four or five hours in the bath, it may be taken out to be wrung, washed, and dried.

In the above manner, by graduating the strength of the solutions, we may obtain all the shades of colour that can be desired. This simple process, the theory of which must be obvious to every chymist, produces a colour which is very agreeable, very permanent, and, above all, very economical. I employ it with success in dying fustians, &c. the colour of which is infinitely more permanent than that of the English ones, having the advantage of alkaline lies. The only defect I have found in the colour is, that it turns brown by the action of astringents.

I thought, for some time, that it might be possible to combine this yellow colour with the blue of indigo, so as to produce a permanent green, but hitherto I have been disappointed in my hopes. It appears, from the different trials I have made with this substance, that there is not a sufficient affinity between the blue of indigo and the oxide of iron; for I could never obtain any other than a dirty, muddy green, very cloudy and faint.

The oxide of iron, on the contrary, combines very readily with the red of madder, and the combination produces a light violet colour, the use of which is as extensive as it is advantageous in the cotton manufactory.

But, if these two colours were to be applied to cotton, without having first employed a mordant capable of fixing the latter, the colour would not only remain dull and unpleasant, from the impossibility of brightening it, but it would also have the great defect of not being able to resist the alkaline lies. We must therefore begin by preparing the cotton as if for receiving the Turkey red; and, when the preparation is carried on as far as the operation of galling, the cotton is to be dipped into a solution of iron, more or less strong, according to the nature of the violet colour desired. The cotton is then to be carefully washed, twice dipped in a decoction of madder, and afterwards brightened in a solution of soap.

When a true violet colour, very rich and full, is required, the cotton is not to be put into the solution of iron till it has been galled: the iron is then precipitated in the form of a bluish oxide, which, when combined with the red colour, produces a very rich purple colour, more or less full, according to the strength of the galling, and that of the solution of iron. It is, however, very difficult to obtain an uniform colour by this process: indeed, an uniform violet colour is considered by the diers as a master-piece; and it is generally supposed, that this great difficulty, of so much consequence in the art of dying, cannot be overcome without the most skilful management. Nevertheless, I am convinced, that the principal cause of the irregularity in this die is, that the iron deposited on the cotton becomes oxidated merely by exposure to the air, which exposure varies in different parts of the cotton. The threads which are on the outside of the skein, are strongly oxidated; while those on the inside, not being exposed to the action of the air, suffer no change. It therefore follows, that the inside of the skein acquires a faint colour, while the outer part acquires a very dark violet. The only way to prevent this inconvenience is, to wash the cotton when it is taken from the solution of iron, and to put it into the decoction of madder while yet moist. The colour thereby becomes more uniform and more rich.

The solvents of iron, for this colour, are nearly the same as for the yellow colour already mentioned.

I shall omit every thing respecting the manual operations of the process, and shall confine myself merely to the chymical ones; for which reason, I shall mention an observation which may serve as a guide to the workman, in brightening the violet colour upon cotton.

The red of the madder and the oxide of iron, by being deposited on the cotton, produce a violet colour. This colour inclines to red, or blue, as one or the other of these two principles predominate. The dier knows, by experience, how difficult it is to obtain such a combination as will produce the shade of colour he desires, especially when he wishes it to be very full, brilliant, and permanent. It may, however, be obtained, not only by varying the proportions of the two colouring principles, but also by varying the process of brightening. It is only necessary to be acquainted with the two following circumstances, *viz.* that barilla destroys the iron; and that soap, by strong boiling, consumes the colour of the madder. For this reason, the colour may be made to incline to red, or to blue, according as the brightening is performed with one or the other of these mordants. Thus, cotton taken from the madder bath, washed, and brightened with a proper quantity of soap, will be of a rich violet colour; whereas, by brightening it with barilla, we shall obtain only a light violet colour.

The oxide of iron, when precipitated on any stuff, combines very advantageously with the fawn colour furnished by astringents; and, by varying the strength of the mordants, an infinite number of shades may be produced. In this case, the result is rather a simple mixture, or juxtaposition, of the colouring particles on the stuff, than a chymical combination or solution of principles. We may indeed, by a boiling heat, combine the oxide of iron more intimately with the astringent principle; it is then brought into the state of a black oxide, as Berthollet has observed.

It is possible also to turn these colours brown, and to give them a variety of shades, from a light grey to a deep black, merely by dipping the cottons, impregnated with the astringent principle, into a solution of iron. The oxide itself is then precipitated by the astringent principle, which is fixed upon the stuff.

A circumstance which may become of great importance to the art of dying is, that all the most usual vegetable astringents afford a yellow colour, which, although it is not very bright, is sufficiently durable to be advantageously employed. This yellow colour in vegetables is capable of being brightened in proportion as the astringent principle diminishes, and the liveliness of the colour increases in the same proportion. It is, on this account, difficult to obtain yellow colours which are at the same time durable and brilliant; these two valuable qualities being in an inverse ratio to each other.

But it is possible to mix these two colouring principles in such a way as to unite durability to brilliancy. Green oak bark unites perfectly well with woad or yellow weed (Reseda Luteola ;) and sumach unites well with quercitron bark. From such mixtures, in combination with the oxide of iron, we may produce vegetable colours, the brilliancy of which is equal to their durability.

I shall conclude these reflections with an observation relative to the use of astringents in dying cotton.

It has been supposed that, in dying cotton red, the place of galls might be supplied by an increased quantity of sumach, alder bark, or oak bark. I wish this were the case, as the high price of galls very much enhances the expense of the colours died with them ; whereas I could procure sumach at a low price, as it grows almost every where in the dry parts of our southern provinces ; but I can affirm, that it is impossible to supply the place of galls with these substances, in whatever proportion they are employed ; the colour produced from them being always more pale and faint, and less permanent. I know that what is here said does not apply to dying wool and silk, for which the above substances are successfully employed ; and, upon considering the cause of this difference, it appears to me to arise from the nature of the galls. In the first place, the acid they contain is different from that of other astringents (as Berthollet has proved) and facilitates the decomposition of the soap with which the cotton is impregnated ; hence, a greater quantity of oil remains fixed in the substance of the cotton, and is more intimately combined with it. Secondly, galls, being produced by means of insects, always retain a certain degree of animal nature, which they impart to the cotton, thereby increasing its affinity to the colouring principle of the madder. The use of animal substances in facilitating this combination is well known ; but wool and silk being themselves animal substances, it is unnecessary, in operating upon them, to make use of galls.

# MR. JOHN LEWIS'S PATENT

## FOR A MEANS OF PREVENTING ACCIDENTS IN WHEEL CARRIAGES. DATED FEBRUARY 1802.

THE specification of this patent describes three contrivances for preventing accidents to carriages.

The first is a method of disengaging the horses from the carriage at pleasure; to effect this, a sort of catches are contrived, which secure firmly in their places, the extremities of all the traces, back-bands, and other straps, which connect the horses with the carriage, as long as they are untouched; but which has each a spring bolt so fixed, that on drawing it in one direction, the strap is instantly disengaged from it; small chains, or wires, run from each of these bolts, and finally unite in one chain, which running over a pulley, or connected with a crank or quadrant to alter its direction, passes into the carriage, to the handle; which, on being pulled, of course draws all the bolts, and disengaging every connection of the horses to the carriage, separates them effectually: where necessary, the direction of each separate chain or wire is altered by a pulley, or crank, in a similar manner to that of the principal chain which communicates motion to them all. It is easy to conceive how these principles may be applied to carriages of different constructions.

The second contrivance, applicable to all carriages, is a ratchet wheel with a catch, commanded by a wire or chain, in somewhat similar manner to that already described, on pulling which the catch falls into the ratchet and prevents its turning but in one direction: one of these ratchet wheels is to be made fast to each wheel of the carriage, by which it may be prevented from running down hill, when the horses are disengaged, or prevented from pressing on the horses in a similar situation

The third contrivance is intended for two wheel carriages; it consists of a sort of prop united by a hinge, either to the fore or back part of the carriage, and is sustained out of the way by a spring catch under the carriage; from this catch a wire or chain passes, and unites with those, already described, for disengaging the horses, by which means, on the handle before mentioned being pulled, at the same instant in which the horses are disengaged, the prop falls down, and prevents the carriage from pitching over.

As two wheeled carriages are hung so very far back at present, Mr. Lewis recommends that one of these props should be used at the back part of the carriage as well as at the front; he directs that a light wheel, six or eight inches diameter should be placed at the lower extremity of each prop, to prevent their breaking from a too sudden stop of the motion when let down; and that a spring should be fixed to each, both to accelerate its fall, and retain it in its place when down, for which latter purpose a serrated catch, or ratchet, is also fixed to it, which presses against the axle, or some other fixed post, when the prop is down.

## OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

The Society of Arts have offered, and, we believe, given more than one premium for inventions for preventing accidents in carriages, which may be seen described in their transactions: the principle must be nearly the same in all; but those here described seem to be as simple and efficacious as any yet made publick, except that for which Mr. J. Williams obtained a patent. (See Rep. Arts, Vol. I. New Series.)

Two wheeled carriages are much more liable to danger than four wheeled, and depend more on the horses: no contrivance can absolutely ensure safety in them when the horse is unruly: at present they are made so very light, that the least accident breaks them; the shafts particularly are much too weak in all: their seats are also generally hung too far back. It is a mistake to think that this eases the horse; if the weight were thrown forward so as to let him bear a moderate proportion of it, he would move easier, particularly in bad roads, and up hills; and also, as can be demonstrated, would have his power of draught increased, while at the same time the carriage would be rendered much more safe by this arrangement.

A contrivance which has already been adopted in a few instances, would make the shafts much less liable to break, without increasing their weight. In this method they are joined, each by a strong hinge to the carriage, from the under part of which a spring projects beneath each shaft, to the extremity of which it is secured, either by a small brace, or iron loop, fastened to it a few inches before the hinge; this not only prevents the shafts breaking by the yielding of the springs, but also in a great degree renders the jolting motion of the horse less perceptible.

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# EXPERIMENTS AND OBSERVATIONS

## ON CALCAREOUS AND GYPSEOUS EARTH.—BY MR. CHANCELLOR LIVINGSTON.

FROM THE TRANSACTIONS OF THE SOCIETY FOR THE PROMOTION OF AGRICULTURE, ARTS, AND MANUFACTURES, INSTITUTED IN THE STATE OF NEW YORK.

THE use of *Gypsum* as a manure, seems in some measure to have created a new era in agriculture; prior to this it was generally admitted, that, though farming might rank among the rational amusements, it could not be considered as a profitable employment for those whose avocations or dispositions do not permit them to attend to that infinite catalogue of minutiæ, which high wages to the labourer, and the low price of produce render essential in our rural economy. The farmer's profit, being the joint result of the fertility of his ground and his labour, the excess of the first can only compensate for a deficiency of the last. Thus the acquisitions of the gentleman farmer, (who may lay his account in being worse served than the common husbandman) must be principally derived from the means which a large capital affords him of fertilizing his ground.

These means, however, are too often beyond the reach of those, even who are willing to purchase them. Calcareous earths are within every man's reach, and yield so certain a return from soils to which they are adapted, as to ensure a decided profit upon the capital employed in procuring them.

It is now three years since I have commenced my experiments upon *Gypsum*. I shall lay the result before the society; though they may not appear new to many gentlemen present, they may incite others to a further prosecution of this subject, and to a more regular and accurate register of their experiments, than can be expected from one in my situation, who can only pursue agriculture as an amusement—which must, like every other pleasurable relaxation, give way to the duties which my station requires.

After stating a great number of experiments, the honourable writer draws his inferences, and explains his opinion of the theory of the operation of this species of manure as follows.

1st. That Gypsum in small quantities has no visible effect on wheat or rye.

2d. That it is uniformly beneficial to Indian corn, unless it be in very rich or very wet soils.

3d. That it is beneficial to flax on dry poor sandy land.

4th. That it is peculiarly adapted to the growth of clover in all dry soils, or even in wet soils, in a dry season.

5th. That limestone pulverized has similar effects with *gypsum;* whether it is better adopted to wet soils, I cannot yet determine.

6th. Another fact seems to be very well established, though I can say nothing of it from my own experience, to wit, that its effects as a manure are hardly perceivable in the vicinity of the sea.

I know not whether these facts will be deemed sufficient to serve as the basis of a theory on the nature of this manure; but as this subject appears involved in difficulties, which no one has yet attempted to remove, I conceive that the man who in doubtful cases hazards even a defective theory, helps to enlighten a subject, by provoking others to combat his opinion. The first step in determining how *calcareous* or *gypseous* earths operate as manures, is to acquire a knowledge of their constituent parts; and for that purpose I could have wished for a more accurate analysis of them than my imperfect knowledge of chymistry has permitted me to make. I mixed a quart of pulverized *gypsum* with an equal quantity of wood ashes, and leached it with boiling water; as it evaporated, it deposited a salt of a dirty brown colour, the crystals imperfectly formed. It was saturated with a solution of potashes, and, when cold, shot into regular crystals, which were sharp at the point, and broad at the base, not unlike to the blade of a small sword. Though this is not the form of vitriolated tartar (which is the salt produced from the vitriolick acid and a vegetable alkali) the difference may have arisen from a metallick gas, which might have been detached from the glazing of the vessel in which it was boiled. This I the rather imagine, as I afterwards obtained vitriolated tartar by suffering the liquor to evaporate slowly in the open air, to which it was exposed for three weeks. Pulverized limestone, treated in the same way, gave a neutral salt, consisting of a great number of long thin needles, equally thick at their extremity. As this is the salt produced by combining fixed air with the vegetable alkali, it proves that the essential salt of limestone is *fixed air*, which shows a difference between that and *gypsum*, that may in certain circumstances be of consequence, particularly in soils that abound with a vitriolick acid, as many boggy soils do; in which case the limestone should be preferred, since the elective attraction between fixed air and *calcareous* earth is weaker than that which exists between this and the vitriolick acid; the first will therefore be dislodged, and the superabundant acid of the soil be absorbed by the *calcareous* earth.

It is evident, then, that *gypseous* earths contain an acid, capable, when united with an alkali, of forming a neutral salt, in which water is a principal ingredient. This earth also contains phlogiston, or a principle of inflammability; as I infer, 1st, from limestone being used as a flux for substances which cannot otherwise be reduced by fire, as pure clay, &c. &c. 2d, from its having once formed part of an organized animal; 3d, from some experiments of Dr. Priestly, in which he expressly declares that he got a considerable quantity of inflammable air from chalk, by the application of heat; 4th, from the following experiment, which, being new to me, surprised me much. I put a few spoonfuls of chalk into a glass bottle, to which I poured strong white wine vinegar, and corking the bottle (after the first ebullition was over) at the end of a fortnight, I found the vinegar from a transparent, converted into a dirty black liquor. This change of colour I can only account for by supposing that the phlogiston, contained in the chalk, was set loose by its decomposition. and imbibed by the vinegar.

Thus, then, we find in a *calcareous* earth, most of the elements that go into the composition of vegetables, to wit, earth, air, fire, water; and an acid, capable, by its combination with alkalies, of forming a salt which shall dissolve in water, and fit all these substances for entering the absorbent vessels of plants.

[Watson's El: 257.] Vegetables, on distillation, yield earth, an acid liquor, fixed and inflammable air, an oil and an alkali. In some vegetables the acid and alkali are actually found united, as in tobacco, sun-flowers, &c. and although chymists doubt whether the alkali is not produced from the acid in the act of combustion, yet I think this question is decided by the analysis of tartar, which the vinous juice of most plants yield, and which is found to consist of an acid and an alkali. Margraff obtained pure nitre from it by saturating it with nitrous acid.

From this analysis of limestone, which only differs from *gypsum* in the acid with which it is combined, we might be led to conclude that it aided vegetation, by being converted into the food of plants. But how is it possible to conceive that six bushels of this manure, which does not weigh five hundred pounds, should be converted into twenty thousand weight of grass, which it will produce in two years on the poorest soil? Why will it not have the same effect in the vicinity of the sea, or on wet grounds? And whence do the plants derive their oil and alkalies, since neither are found in this manure?

It has been supposed, that though *gypsum* in such small quantities may not serve as food, it may still operate as the physick of plants, and strengthen their power of digestion. This supposition is liable in my mind to strong objections. 1st. I can hardly conceive that plants (whose lives it would seem must be very regular) should have such weakly constitutions as to require physick from their infancy. 2d. If we judge from the analogy between animals and vegetables, we should suppose that a stimulus constantly applied would lose its effects, and ultimately relax and weaken the patient. 3d. If plants were thus effected by *gypsum*, its advantages should be (contrary to the fact) comparatively greater in rich than in poor soils. To increase the appetite where there is nothing to eat, would be with Shakspeare's Grumio, to furnish the mustard without the beef. 4th. As plants in wet soils are probably most subject to crudities and indigestion, it is supposable that they would be most benefited by stimulants, and yet they receive but little benefit from *gypsum*.

By these objections (which perhaps appear stronger to me than they otherwise would from the support they afford to my system) I am induced to reject each of these theories, in order to make room for the following, which supposes that *calcareous* and *gypseous* earths furnish food to plants, without being consumed by the supply they afford, that they are the stewards, and not the physicians of the vegetable family.

I have observed that two of the ingredients that enter into the composition of plants, to wit, the alkali and oil, were not usually found in *calcareous* earths, the fresh shells of fish, and a few others excepted, from which a portion of oil and a volatile alkali may be extracted. I presume, however, that an ample supply of these is necessary to the vigorous health of plants; and that *gypseous* earths afford them the following process.

The affinity or attraction between alkalies and the acid of *gypsum*, is stronger than that which exists between the stone and its own acid. That is to say, the acid will leave the stone or earth to unite with the alkali, as appeared by the experiments I have mentioned, by which neutral salts were obtained by leaching pulverized *calcareous* stones with the lies of ashes.

When therefore an alkali comes in contact with pulverized *gypsum*, it will attract the acid, and combining with it and water, form a neutral salt, while the *calcareous* earth, deprived of its acid, becomes caustick. Let us then suppose *gypsum* pulverized and spread thinly over the earth, it is evident that in this case it exposes a large surface to the action of the air; if this contains a volatile or vegetable alkali, which I shall by and by show that it does, this alkali will seize upon the acid of the stone, and form a neutral salt. Salts I believe cannot crystallize but by the addition of water, which in their combination loses its fluidity and becomes a solid body; the fluidity of water depends upon its heat; it must therefore before it becomes solid, part with its heat, probably in the form of inflammable air. As all plants possess this, they must have some means of seizing upon it when brought within their reach. They will therefore either absorb it by their leaves, or it will attach itself to the water that it finds in the air or on the earth, and thus be imbibed by the plant. Chymists suppose that this air which becomes fixed in plants, causes the production of oils, though by what combination they are not yet satisfied. (*Fourcroy's* Chymistry, 55, second edition.)

This then is one mode in which *calcareous* earth may supply the oils and inflammable principle found in vegetables; since plants imbibe inflammable air and emit it pure, retaining the phlogiston or inflammable part, which is known to be a principal ingredient in them; the acid and alkali will also be furnished, when the moisture of the air, dews or rain dissolve the neutral salts they have formed, and by rendering them liquid dispose them to enter the absorbent vessels of plants. In this solution, the water which had lost its heat where it crystalized, will again resume it with great rapidity from the air in contact with it. As the repulsive power or elasticity of the air depends like that of all other fluids upon heat, it is not unreasonable to suppose that the sudden assumption of heat from the inflammable air which composes a great proportion of the atmospherick air, will decompound it, and compel it to deposit its water, earth, oils and whatever other substances is found floating in it. If inflammable air is contained in a receiver, and an electrick spark passed through it, it may be made to deposit a considerable quantity of water, which is always combined with it. In this way then oils and even earth may be supplied, for it is certain that the water contained in the atmosphere possesses a portion of earth, and perhaps no other earth but this is sufficiently attenuated to enter the absorbent vessels of plants. Thus a gallon of rain water distilled, yields about sixty grains of *calcareous* earth, which accounts for the increase of certain plants without either earth or water, and which are still found to contain both. Should it be denied that the attraction of the heat from the atmosphere is capable of decompounding it, it will nevertheless be admitted that there are an infinite variety of vapours which are exalted by the summer's sun, which owe their levity to heat only, and not being permanently elastick, must fall when the heat is attracted from them. Thence the fertility occasioned by dews impregnated as they always are with heterogeneous substances; such of those vapours therefore as float near the earth's surface (and those will be most fertile) will suddenly be condensed by any extraordinary degree of cold, which the solution of the salt I have mentioned may occasion. But the effect of the *calcareous* earth does not stop here; it is not satisfied with a single operation, but like a faithful steward still exerts itself for the support of the vegetable family committed to its care. This earth, when deprived of its acid is rendered caustick, and will therefore greedily imbibe the acid from the air, after which it will be brought back to its original state, and will form new combinations with alkaline vapour, and the same process will be continually repeated, till it is itself dissolved in water, born away by the air, or absorbed by plants, to all which casualties it is subjected. That acids exist in the air is proved, 1st, From their being capable not only of evaporation, but of being rendered permanently elastick, and even in this state capable of combining with alkalies, which can in like manner be rendered permanently elastick. From their union, a white cloud is produced, which contains a neutral salt. 2d, If quick lime is kept dry, and exposed a long time to the air, it will become effete, and lose its causticity by its reunion with an acid. 3d, If a cloth moistened by a strong solution of pot ashes is exposed to the air, it will be covered with saline chrystals of vitriolated tartar. 4th, If the earth from which salt-petre has been made is exposed to the air, it will recover the nitrous acid it had lost. In some parts of the East-Indies saltpetre is made by setting fire to a long grass which grows on the declivities of hills; that ashes serve as the alkaline base of nitre (which is a neutral salt composed of an acid and an alkali) the acid of which floats in the air and combines itself with the alkali, forming the salt which is washed down by the rains and received in reservoirs at the foot of the hills, where the water is evaporated and the salt crystallized.

This part of the theory will therefore hardly admit of a doubt. The existence of an alkali in the air I think is proved from the extreme volatillity of some alkalies; from the possibility by heat alone of rendering them permanently elastick; from their being continually exhaled from burning and putrifying substances. Dr. Black imputes the rust of metals to the action of an alkali existing in the air, and says alkaline salts are often collected from the corks of bottles containing acids—the atmosphere itself is a compound, which differs so essentially from pure vital air, as to contain only twenty-eight parts in a hundred of it; the rest is fixed and inflammable air, fire, earth, water, and an infinite variety of other substances, besides vapours that are not permanently elastick. The purest earths, the hardest metals, may be converted into air, and float in the atmosphere, which may itself be changed into water, and water into solid earth.

What strikes me as a further evidence of the existence of an alkali in the air, is, that such parts of flint or limestone, as are exposed to the action of the air and water, are always white and soft; flint I believe is not soluble in acids, but will dissolve in alkalies; nor can the decomposition of limestone, be attributed to the action of acids, since, as this is very gradually affected, it is to be presumed, that if the acid in the air was strong enough to expel the fixed air, it would unite with the *calcareous* earth, and still form a salt with an earthy basis of a different species. May we not then conjecture, that this change in the limestone is caused by a combination of the kind I have mentioned; and the rather, as we find when it is exposed only to the action of the air, and not washed by water, that it forms saline efflorescences, which speak the union of alkaline acid, and earthy substances. Dr. Watson tells us, that from the mortar of an old barn that was covered with these efflorescences, he extracted perfect crystals of pure nitre, without the application of any alkali; and yet we know, that an alkali and an acid are essential in the composition of nitre. He does not attempt to account for this. I should however presume, that it could only happen by the lime in the mortar, having recovered a nitrous acid from the air, instead of the fixed air it had lost, and that the putrid exhalations from the vegetables contained in the barn had furnished the alkali, and that from the combination of these, with the moisture of the air, resulted those efflorescences that formed the nitre. Dr. Black asserts, that the efflorescences found in damp caverns or cellars in England, contain a great proportion of *fossil alkali*—this alkali is not found in Europe, unless combined with sea salt, of which it makes the basis; and yet these efflorescences are derived from the moisture of the air: does not this argue the existence of an alkaline salt in the atmosphere?

It may be objected, that if alkalies and acids exist in the atmosphere, they would by their union form neutral salts in the clouds. Though I by no means consider this as a necessary consequence, since the repulsive power of the particles of air, may keep the alkalies and acids they contain without the sphere of each other's attraction, yet I am inclined to believe, that this combination does actually take place. To the heat generated by this combination while the salts are forming, I attribute the variations that are felt in the degrees of heat that prevailed at different times, in the stillest weather, when summer heat should be uniform; to the solution of these salts, that cold which generates frost and hail in the warmest seasons.

There are places among the mountains, and in great forests, where frosts prevail every month in the year. There are others, which by clearing are freed from this calamity, which is known so often to distress the first settlers of a new district. If frosts were occasioned merely by the influence of cold winds, the places most exposed to these would be subject to them, and woods and vallies would afford a shelter against them, as indeed they often do against frosts which are derived from this source The reason of the prevalence of frost in woods and sheltered vallies, when the general temperature of the air elsewhere is warm, I should take to be the greater exhalations of those substances that form salts, and the solution of them by the vapours that arise from these moist and sheltered situations. Hail too cannot be ascribed to any other cause; if it owed its origin to cold only, it would be more prevalent in winter than in summer; it would, like showers of rain, extend over large tracts of country; and it would fall from much greater heights than it generally does. But hail, like frost, is often confined to a very narrow region, prevails in the warmest weather, and in long close vallies at a distance from the sea, more than in the open country or near the ocean. Thus France and Italy are extremely incommoded by hail storms; in England they are very rare. All these phenomena correspond with the theory laid down: in summer are the greatest exhalations of volatile alkalies. These are more likely to arise, and form their union with the aerial acids in vallies where the air is most compressed; in these situations they frequently meet with those moist clouds that dissolve them suddenly, and afford the water that is by the solution of the salts converted into hail. The salt composed of an acid and a volatile alkali, a sal-ammoniack, dissolves with great rapidity when it comes in contact with water, and generates a great degree of cold; while common salt dissolves much slower, and does not generate so much cold by eighteen degrees in its solution; for which, (among other reasons) hail prevails less near the sea than at a distance from it. That such salts are formed in the air is further proved from the experiments of Margraff

NOTE—The rust of iron will yield a volatile alkali—rust is acquired by exposure to the air. [Black.]

and Doctor Ratty, who both obtained a bitter salt from snow and rain water in distillation, but much less from snow than from rain water. Doctor Black admits that both nitre and common salt are formed in the air. A farmer needs no better proof of the existence of the latter in the atmosphere on the south side of the Highlands, than the indifference which cattle show there for salt, and the eagerness with which they seek it at a greater distance from the sea. I shall now endeavour to reconcile certain phenomena in the operation of *gypsum* to this theory.

1st. It benefits dry more than wet soils.

Because *calcareous* and *gypseous* earths are at all times soluble in the water. In wet soils they will be dissolved and wash away; besides, the moisture which invelopes the particles of *gypsum*, protects it from the action of the air, and prevents the combinations on which this theory is founded. As limestone is less soluble in water than *gypsum*, perhaps if applied in large quantities, it may be more beneficial to moist land.

2d. It is proportionally more advantageous to poor than to rich soils.

1st. Because the putrid vegetables which compose a rich mould afford a sufficient quantity of alkalies, oils and acids, but principally because after the *gypsum* has parted with its acid by combining with the alkali, as before supposed, its earth being thereby rendered caustick, combines with oils with which such soils abound, and is thus sheltered from any further operation of the air upon it. Perhaps too the vitriolick acid instead of uniting with an alkali, is attracted by the oils it finds in the earth; these it renders viscous, and by its combination forms sulphur, and thus is rather hurtful than serviceable—on such soils pulverized limestone should be preferred.

3d. It is less beneficial near the sea than at a distance from it.

1st. Because the winds that blow from the sea which are the prevalent summer winds, and probably less impregnated with those alkaline substances which putrid animals and vegetables afford, than those which blow over a large tract of land.

2d. Because it appears from experiments made in Ireland, that sea salt is contained there both in rain and snow water. Sea salt is composed of the marine acid, and a fossil alkali, to which latter the vitriolick acid found in *gypsum* has a greater affinity than the marine acid; it will therefore decompound the salt and unite with the fossil alkali perhaps, (I speak with deference, not knowing the fact) perhaps, I say, the fossil alkali may be unfriendly to vegetation, or not of a nature to be absorbed by the plant. In this case on the solution of the salt formed with it and the vitriolick acid, the latter would be absorbed singly and the fossil alkali being left, would form new combinations with the marine acid, which is found in the atmosphere near the sea, and be again converted into common salt, which is known to have little or no effect as a manure. That the vitriolick acid would be absorbed, I infer from the presence of vitriolated tartar in pearl ashes, which shows that the acid must have existed in the plants from which it was made, and from the following fact which I have seen in some writer on husbandry:—A gentleman whose court yard was overgrown with weeds, was advised to sprinkle them with vitriolick acid, but to his great surprise he found that instead of killing them they grew with additional vigour. That fossil alkali is unfriendly to vegetation, I infer from its not being found in any plant, some marine plants excepted. Perhaps in the vicinity of the sea, if pulverized limestone could be afforded sufficiently cheap, and was used in large quantities, it might be found beneficial, because its acid or fixed air is not sufficiently powerful to detach the marine acid from its fossil alkaline base. This idea seems to be justified by the general use of chalk in England, and limestone gravel in Ireland, and the beneficial effects that are known to arise from the use of sea shells applied in large quantities on Long-Island and elsewhere.

There is a remarkable fact which may perhaps be adduced to strengthen my theory, and to show that either the air or earth is less impregnated with alkalies near the sea, than at a distance from it. The Long Island farmers send annually a number of boats to collect the ashes from the potash works along the banks of the Hudson, and at the distance of two or three miles from it. These they purchase at 2d. per bushel; pay the expense of a cartage to the river; of a water transportation of 120 or 130 miles, and then cart it again two or three miles to their farms, while a North river farmer, if the ashes were given him, would not be at the expense of carting them three miles. This has by hasty observers been attributed to ignorance, or indolence in the latter. The reproach is unmerited; the people on the north side of the Highlands are not less enterprising or intelligent than those on the south; they are the same people. The fact is, that lands near the sea derive much greater advantage from alkaline manures, than those at a distance; ashes will contribute to fertility every where, but much more so (if I can rely upon the information of intelligent farmers on Long Island, compared with my own observations) in the vicinity of the sea, than at a distance. I have myself never been able to procure half the grass from an acre of land manured with 100 bushels of undrawn ashes, which cost, exclusively of the expense of putting it on 5*l.* that six bushels of *gypsum* has given me from the same field; it is also on my farm the least permanent of all manures; the effect of it not being visible after the second year.*

I will intrude upon your patience one moment longer, while I mention another fact which appears to me to support my theory.

It is generally asserted that *gypsum* renders the earth black. It is well known to those who have been attentive to its effects, that bare spots in a field that has been manured with it, will discover a great number of small black specks, particularly on sandy grounds that have been wet. It is also known that beds of oyster shells, and the thin stratum of earth that covers limestone rocks, is always black, like the richest vegetable mould. Now, as these substances are white when reduced to powder, from whence can they derive the power of rendering the earth in contact with them black? Unless in their decomposition they attract oils from the air, or communicate the phlogiston they contain to the moist earth, as the chalk appeared to do to the vinegar in the instance I have mentioned. We may add to this, that ground which lies over a stratum of limestone rock is less subject to frost, and thaws earlier than any other soil. Both oils and salt have a considerable power in resisting frost.

Should the system I have endeavoured to establish be true, it will follow that *calcareous* earths are very permanent manures in proportion to the quantity employed. For, as I have before observed, if this is small it must be

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* Note—The chancellor's seat at Clermont, where his experiments were made, is one hundred and twenty miles from the sea coast.

frequently renewed, because this earth is soluble in water, and will be carried off by it, or imbibed by the plants themselves.

As far as experiment has gone, this opinion of its duration is fully justified. Oyster shells, craig, marle, last for ages in full vigour; these are all different modifications of this earth.

Whether my ideas on this subject are just or not, I confess I take a pleasure in thinking them so. I class in my own mind this effect of *calcareous* earths with the provision which nature in the creation of coal mines has made for after ages. I consider it as a proof of the duration of this globe for many thousand years to come. It is evident that the vegetable tribes flourished long before men were sufficiently numerous to make war upon them; left to themselves for centuries, they grew, flourished, faded, and died, and by their death and putrefaction, covered the earth with a rich mould, from which men and other animals have hitherto drawn their support. This, however, must gradually diminish; vegetable substances are not suffered as formerly to cover every part of the earth; to die and putrify on the spot on which they grew; animals take more from it than they return; every rain draws down a part of it to the hidden caverns of the earth; every stream and rivulet hurries it into the sea; every fire preys upon it; every breeze is impregnated with its spoils. Let us not, however, tremble for the fate of posterity; the fossils which the sea affords, the vast quarries of marble, chalk, gypsum, marle, which all derive their origin from the same source, not only restore the loss which the water occasions, but, agreeably to this system, compel the air to deposit the spoils of the vegetable world, and the fires which have consumed the old, to animate new plants.

## REMARKS BY T. G. F.

The foregoing ingenious theory of the honourable chancellor is coroborated by those chymists and writers on agriculture whose works I have been able to consult. It may, perhaps, be said of the phenomena of vegetation, as was remarked by a modern writer (I think Park in his work entitled THE CHYMICAL CATECHISM) of combustion, that it is merely "*a play of affinities.*" And those substances which will best contribute to support and stimulate this action of affinities, will be found of the greatest utility as manures.

Calcareous earth (lime) and its sulphates (gypsum, selenite, or plaster stone) have a great affinity to *water*, as well as to the acids and alkalies which are held in solution both by water and by atmospherick air. Gypsum, pulverized will acquire weight, and become moist by simple exposure to atmospherick air, under cover in the driest season. "Lime seizes water with great avidity; at the same time that it falls into powder, increases in bulk and emits heat." Nicholson's Chaptal, The importance of water as a nutritive principle to plants is well known. I will, however, indulge in a further quotation from the work cited above.

"Every one knows that a plant cannot vegetate without the assistance of water: but it is not so generally known *that this is the only aliment which the root* draws from the earth, and that a plant can live and propagate itself, without any other assistance than the contact of water and air. It appears to me, nevertheless, that the following experiments remove every doubt on this subject: Van Helmont planted a willow, weighing fifty pounds, in a certain quantity of earth, covered with sheet lead: he watered it for five years with distilled water; and at the end of that time the tree weighed one hundred and sixty-nine pounds three ounces, and the earth in which it had vegetated was found to have suffered a loss of no more than three ounces. Boyle repeated the same experiment upon a plant, which, at the end of two years, weighed fourteen pounds more, without the earth in which it had vegetated, having lost any perceptible portion of its weight.

"Messrs. Duhamel and Bonnett supported plants with moss, and fed them with mere water: they observed that the vegetation was of the most vigorous kind; and the naturalist of Geneva observes, that the flowers were more odoriferous and the fruit of a higher flavour. Care was taken to change the supports before they could suffer any material alteration. Mr. Tillet has likewise raised plants, more especially of the gramineous kind, in a similar manner; with this difference only that his supports were pounded glass, or quartz in powder. Hales has observed that a plant which weighed three pounds, gained three ounces after a heavy dew. Do we not every day observe hyacinths and other bulbous plants, as well as gramineous plants raised in saucers, in bottles containing mere water.*

"All plants do not demand the same quantity of water; and nature has varied the organs of the several individuals conformably to the necessity of their being supplied with this food. Plants which transpire little, such as the mosses and the lichens, have no need of a considerable quantity of this fluid; and accordingly they are fixed upon dry rocks, and have scarcely any roots; but plants which require a larger quantity have roots, which extend to a considerable distance, and absorb humidity throughout the whole surface."

Calcareous earth, however, has other, and powerful affinities beside that which induces it to seize on water. Lime and its sulphate, gypsum, combine with all acids, particularly the nitrick and muriatick.† The nitrick acid is composed of oxygen and nitrogen; the latter serving for food, and the former for stimulus for plants. Lime, then, or its sulphate, gypsum, by its attraction for the nitrick acid, and the substances of which it is compounded, to wit, nitrogen and oxygen, furnishes both food and stimulus to vegetables. But it has likewise an attraction for the *muriatick acid.* This last is obtained from sea salt, is of a corrosive nature and when combined with oxygen is very poisonous to animals and vegetables.‡ Its deleterious effects may be traced on vegetables, according to Kirwan and others, for several miles from the sea coast, particularly after a violent storm, which has covered them with spray and vapour from the sea. The atmosphere, near the sea shore, always holds in solution a portion of the muriatick acid, which, attracted by gypsum, furnishes vegetables with poison instead of food.

* If proper care was taken to renew this water, the plants would probably grow with more luxuriance.

† Parkinson.

‡ The death of the ingenious and indefatigable Pelletier was occasioned by his attempting to respire oxygenized muriatick gas. A consumption was the consequence, which, in a short time, proved fatal. Dr. Thomson, Vol. II. p. 82.

# ON THE MEANS

## OF MAKING BREAD FROM RICE ALONE.

FROM THE JOURNAL DES SCIENCES, DES LETTRES, ET DES ARTS.

THE art of making bread from rice, though much spoken of, seems to be very little known. In Chomel's dictionary it is said that bread may be made of rice, but there is no account of the means by which it is to be done. The book called *La Maison Rustique* goes rather further; for, it informs us that this kind of bread is made by mixing together the flour of rye and that of rice. The first of these books, therefore, may be considered as saying nothing, since it is absolutely impossible to make bread of the flour of rice (which is harsh and dry, like sand or ashes) by treating it in the manner in which wheat flour is treated. The manner of using rice flour described in the second book, is but an uncertain remedy in case of want; for, if we have no rye, we cannot, according to that book, make use of rice flour for making bread, because an equal quantity of rye flour is said to be necessary for that purpose; and consequently, in countries where no rye is grown, it would be impossible to make bread of rice, however great the want of bread might be.

I therefore think it my duty to supply that information which is wanting in the two books above mentioned, by describing a method by which excellent bread may be made from rice alone, which method I learned from the natives of America.

The first thing to be done to the rice is, to reduce it into flour: this may be done by grinding it in a mill, or, if we have not a mill, it may be done in the following manner. Let a certain quantity of water be heated in a saucepan or cauldron; when the water is near boiling, let the rice we mean to reduce into flour be thrown into it: the vessel is then to be taken off the fire, and the rice left to soak till the next morning. It will then be found at the bottom of the water, which is to be poured off, and the rice put to drain upon a table placed in an inclined position. When it is dry, it must be beat to powder, and passed through the finest sieve that can be procured.

When we have brought the rice into flour, we must take as much of it as may be thought necessary, and put it into the kneading trough in which bread is generally made. At the same time we must heat some water in a saucepan or other vessel, and, having thrown into it some handfuls of rice, we must let them boil together for some time: the quantity of rice must be such as to render the water very thick and glutinous. When this glutinous matter is a little cooled, it must be poured upon the rice flour, and the whole must be well kneaded together, adding thereto a little salt, and a proper quantity of leaven. We are then to cover the dough with warm cloths and to let it stand that it may rise. During the fermentation, this paste (which, when kneaded, must have such a proportion of flour as to render it pretty firm) becomes so soft and liquid that it seems impossible it should be formed into bread: it is now to be treated as follows.

While the dough is rising, the oven must be heated; and, when it is of a proper degree of heat, we must take a stew pan, of tin or copper tinned, to which is fixed a handle of sufficient length to reach to the end of the oven. A little water must be put into this stew-pan, which must then be filled with the fermented paste, and covered with cabbage or any other large leaves, or with a sheet of paper. When this is done, the stew-pan is to be put into the oven, and pushed forward to the part where it is intended the bread shall be baked; it must then be quickly turned upside down. The heat of the oven acts upon the paste in such a way as to prevent its spreading, and keeps it in the form the stew-pan has given it.

In this manner pure rice bread may be made; it comes out of the oven of a fine yellow colour, like pastry which has yolk of eggs over it. It is as agreeable to the taste as to the sight; and may be made use of, like wheat bread, to put into broth, &c. I must, however, observe that it loses its goodness very much as it becomes stale.

It may be here remarked, that the manner in which Indian corn is used in France, for making bread, can only produce (and does in fact produce) very bad dough, and of course very bad bread. To employ it advantageously, it should be treated like rice, and it may then be used, not only for making bread, but also for pastry.

# OBSERVATIONS

## ON THE EFFECTS OF MORDANTS IN DYING COTTON RED. BY J. A. CHAPTAL.

FROM THE ANNALES DE CHEMIE.

IN dying cotton a fine red colour, by means of madder, it is still the custom, as in certain medical preparations, to adhere strictly to the most whimsical and extraordinary prescriptions, lest any change in the process should produce an alteration in the result.

A month's work is hardly sufficient to complete all the operations supposed indispensable for obtaining the fine red colour, called Adrianople or Turkey red. In the process for which are successively employed the following ingredients, viz. barilla, oil, galls, sumach, alum, blood, the gastrick juice, madder, soap, solution of tin in *aqua regia*, and other substances.

The true means of simplifying this process is not by working at random, and trying without rules and principles, methods different from those at present made use of. That mode of proceeding leads very rarely, and always slowly, to successful results. I know but one way of making any progress in the arts, namely, by reducing all the operations to simple principles ; by this means we obtain fixed points, from which we may take our departure, and to which we may refer the results of our labours. Chymistry is now in a sufficient advanced state to furnish these first bases ; it is only necessary to establish them, and they will become, in the hands of the workman, what formulæ are in the head of the mathematician. I shall give one example of this, by submitting to chymical principles, the action of the three principal mordants employed in dying cotton red, viz. oils, galls, and alum.

It is well known that cotton will not take a permanent red dye from madder, except it has first been properly impregnated with oil. The red given to cotton by printing is far from possessing the same degree of fixity since it cannot support the operation of brightening by means of barilla.

This preliminary preparation is given to cotton, by forming (without heat) a soapy liquor, by the combination of oil with a weak solution of barilla.

This alkaline lixivium is of no use but to dilute and divide the oil, so as to give the workman the power of applying it, with ease, to every part of the cotton, in an equal manner.

I found that potash produced the same effect as barilla; a circumstance which is, in my opinion, deserving of some attention, because, in those parts where barilla is scarce and dear, its place may be supplied by potash.

It follows, from this principle, that all kinds of barilla, or of oil, cannot be employed indifferently.

In order that the barilla should be fit for the purpose, it is necessary that it should be in a caustick state, and that it should contain but a small quantity of sea salt.

It must not be rendered caustick by quick lime, because it then gives the colour a brown hue; its causticity must therefore be produced by calcination.

Barilla which is rendered mild by fixed air, and that which has much sea-salt mixed with it, unite very imperfectly with oil; consequently, old barilla in an efflorescent state, and the impure barilla of our climate, cannot be used in the die here treated of.

The choice of the oil is as essential as that of the barilla.

In order that an oil should be good for this purpose, it must be capable of uniting very perfectly with the solution of barilla, and of continuing permanently in a state of complete combination.

The oil most fit for the purposes of dying, is not fine oil; on the contrary, it is that which contains a large portion of extractive principle.

The former (fine oil) does not preserve its state of combination with the barilla; it also requires a stronger lie; a circumstance which prevents the dier from graduating properly his subsequent operations.

The other kind of oil makes a combination which is thicker and more durable; it also requires but a weak lie, of one or two degrees of strength.

The necessity of producing a very intimate and perfect combination of the oil with the barilla, will be readily perceived, by reflecting, that the lie of barilla (as was before mentioned) is only made use of for the purpose of dividing and diluting the oil, so that it may be applied equally to all parts of the cotton. From this principle it follows, that if the oil is not well mixed, the cottons which are dipped in this mordant, will take the oil unequally, and, consequently, the colour given to them by dying will not have a uniform appearance.

Hence it is, that the workman considers the secret of producing a uniform and rich colour, to consist merely in chusing such oil, and such barilla, as will answer his purpose.

It follows, also, from these principles, that there should be an excess of oil, and not merely as much as is requisite for the saturation of the barilla; for, in the latter case, some of the oil would quit the cotton, when it was washed, and the colour would remain dry.

When the cotton is properly impregnated with oil, it is made to undergo the operation of *galling*. In this operation, galls produce several advantages. First, the acid they contain decomposes the soapy liquor with which the cotton is impregnated, and fixes the oil upon it. Secondly, the animal nature of the galls gives the cotton a disposition to receive the colouring principle. Thirdly, the astringent principle unites to the oil, and forms with it a compound which grows black as it dries, which is almost insoluble in water, and which has a very strong affinity with the colouring principle of the madder.

This last combination may be obtained, and opportunity given of investigating its properties, by mixing a decoction of galls with a solution of soap.

From the above principles it follows, first, that other astringents, in whatever proportion they are employed, cannot be used instead of galls. Secondly, that the decoction of galls should be made use of as hot as possible, in order that the decomposition may be sudden and complete. Thirdly, that the galled cotton should be dried quickly, to prevent its turning black, which would diminish the brightness of the red colour meant to be given to it. Fourthly, that dry weather should be chosen for the process of galling, because wet weather tends to give the astringent principle a black colour, and also retards the drying. Fifthly, that the cotton should be pressed with the greatest care, in order that the composition, about to be produced, may take place equally at every part of its surface. Sixthly, that there should be a fixed proportion observed, in the quantity of galls and soap made use of. If the galls predominate, the colour is apt to be black; if the soap is in excess, that portion of the oil which is not combined with the astringent principle becomes useless, as it is carried off when the stuff is washed; the colour is more faint.

The third mordant employed in dying cotton red, is alum. This substance has not only the property of brightening the red colour produced by madder, but it also contributes, by its decomposition, and the fixity of its earth, to give solidity to the colour.

In order to judge of the effects produced by alum, in dying cotton red, it is only necessary to mix a decoction of galls with a solution of alum. The mixture immediately becomes turbid, and a greyish precipitate is formed, which when dried, is insoluble in water, and in alkalies.

Every circumstance that happens in this experiment, may be observed in the operation of aluming, for the purpose of dying. The cotton, when galled, and dipped in a solution of alum, or of acetite of alumine, changes its colour, and instantly becomes grey. No precipitate appears in the bath, because the precipitation takes place in the substance of the cotton, in which the products of that operation remain fixed. It must, however, be observed, that if the solution of alum, into which the galled cotton is dipped, is too hot, a certain portion of the galls escapes from the cotton, and then the decomposition of the alum takes places in the bath itself; this necessarily diminishes the proportion of the mordant, and thereby renders the colour less rich.

Here then is a combination of three principles (oil, the astringent principle, and the earth of alum) which serves as a mordant in dying red with madder. When these principles are used separately, they produce neither the same fixity, nor the same brilliancy in the colour.

This mordant is, undoubtedly, the most complicated of any known in the art of dying, and it presents to the chymist a species of combination very interesting to investigate.

It is from the exactness of this combination, and from the skill of the artist in making it, that a beautiful colour is to be expected. But, although it may be possible, by taking experience for our guide, to conduct ourselves properly through the labyrinth of these numerous combinations, it is very difficult to render them more simple and perfect. It is only by reasoning upon the operations, and calculating the principle and result of each of them, that we can be complete masters of our processes, can correct the errours of them, and can obtain constant results. Without doing so, the practice of the most experienced artist offers only a discouraging alternation of successes and failures. It was my view, in the analysis I have here given of the operation of dying red with madder (the most complicate of all such operations) to give an example of the assistance chymistry can afford to the arts, when it enlightens them by its principles. And I am convinced that the most ignorant workman will find, in this short explanation, the principles of his work, and the rules by which he ought to conduct himself.

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# EXPERIMENTS

## MADE ON A LARGE SCALE ON THE MELTING OF IRON IN A REVERBERATORY FURNACE. BY G. A. LAMPADIUS.

JOURN. DES MINES, NO. 94. VOL. XVI.

THE reverberatory furnace used in these experiments consists of three principal parts: 1. the air-tunnel and ash-hole; 2. the fireplace; 3. the hearth and chimney. The air was conducted through a vertical tunnel several yards in length, with its lower aperture over a stream of water. The fuel employed was wood; the bottom of the furnace was an oval cavity capable of containing three or four hundred weight of metal. The flame escaped through a chimney eight ells high.

In using this furnace a multitude of unoxydated particles of carbon were observed in the flame of the closed furnace, which communicate to the latter the property of reducing or disoxydating metal.

Experiment I. *with the simple fire of the furnace.*— Grey, fine-grained cast iron being put into the reverberatory furnace, became covered with a scoria consisting principally of carburet of iron. This scoria could not be removed on account of the metal that adhered to it. The metal being brought to ebullition, carburetted hydrogene gas was evolved. After five hours boiling, during which the melted mass was frequently. stirred and the scoria mixed with it, it became white and coarser grained, appearing more malleable, but yet not capable of being forged. In the ordinary refining furnace, it was refined sooner than common cast iron. The process of refining iron by the reverberatory furnace shows that the cast iron was here converted into malleable by means of the oxygene contained in the small quantity of atmospherick air, which, jointly with azote and carbonick acid gas, covered the fused metal. This oxygene combined with the carburet of iron, whereby carbonick acid gas and oxyde of iron were formed, and this produced the frothy scoria. This scoria, by reason of its lightness, rose to the surface at the beginning, but was destroyed as soon as the air began to act.

Experiment II. *The fire of the furnace being aided by the vapour of water.*—By igniting the carburet of iron the water was decomposed, and carbonick acid gas, hydrogene gas, and oxyde of iron obtained. This being found to be the case when the experiment was tried on a small scale, the principle was applied to the refining of iron in the reverberatory furnace.

Three hundred weight of cast iron were put into the reverberatory furnace as before, steam was introduced, and the operation proceeded rapidly; but when, at the end of four hours, it was supposed to be finished, the iron was found of fine grain, and full of holes. When treated afterwards in the same manner as the preceding, it was found less capable of being refined than before. On assaying a specimen in the state in which it came out of the reverberatory furnace, it was found to contain more oxygene than other kinds of cast iron. Half a pound of grey cast iron treated in a retort with four ounces of charcoal, purified of all carbonick acid gas, had been found to yield 32* cubick inches of carbonick acid gas. A like quantity of white cast iron gave 165 cubick inches of the same gas. Four ounces of the cast iron just taken from the reverberatory furnace, mixed with two ounces of charcoal, gave 96 inches, or 192 inches to half a pound. Thus the proportions of oxygene contained in these different kinds of cast iron are:

| | |
|---|---|
| In iron superrefined with steam - | 192 |
| Common white cast iron - - - | 165 |
| Grey cast iron - - - - - - - - | 95 |

* Probably this is an errour of the press in the original, as it does not agree with the proportion specified in the next paragraph; consequently one of the two must be wrong.

This superrefined iron is probably formed as follows: the steam is decomposed, and destroys its carburet, as atmospherick air does in the ordinary refining; at the same time it communicates to the iron so large a quantity of oxygene that it was necessary in the refining not only to separate the scoria, but likewise to disoxydate the metal. This experiment, moreover, confirms the property which iron possesses of becoming oxydated at different degrees.

Experiment III. *The fire of the furnace being aided by the action of bellows.*—A bellows being adapted to the reverberatory furnace, a much greater heat was produced than in the two preceding experiments. A very fluid scoria was formed, of a dark brown colour and vitreous fracture, which could not be removed. Stirring the mass produced extraordinary heat with a scintillating combustion. The operation being ended, the iron was found to have lost considerably in weight. Its fracture was silvery, compact, and interspersed with a great number of spherical cavities, indicating the disengagement of a gaseous matter during the fusion. This mass was too small to be refined. Four ounces yielded 87 cubick inches of oxygene gas, consequently nine less than that which had been treated with steam. Thus probably the oxydation was here also too powerful; and as the metal did not become doughy, it must have been supersaturated with oxygene, without passing through the malleable state. The carburet, indeed, must have been totally destroyed, whence the silvery colour.

## REMARKS BY T. G. F.

We observed in a former article, page 26 that water in certain circumstances was a supporter of cumbustion and was capable of being converted into fuel; and the above corroborates our former assertion. Dr. Mitchell, in a letter to Dr. Priestley, published in the Medical Repository, New York, vol. 1. page 504, relative to the disputes among chymists concerning phlogiston, remarks as follows:

" Having subjected water heated to the temperature of steam in an eolipyle, and directed the steam, issuing from it, to the surface of red hot charcoal, the coal brightened, and a greater flame was observed near the spot against which the steam was made to play. Here was an occurrence opposing the common observation of mankind, that water will always extinguish fire by reason of its own incombustibility. Water kept at or below a certain temperature will extinguish fire, and so will oil; but if water be raised to heat sufficiently high, it will also burn, or undergo decomposition like oil. As far as I could judge from the phenomena before me, water in proper circumstances, underwent a true combustion, and was inflammable for the same reason that oil was, because it contained a something that would burn, and this something seemed to be exactly similar to that which made oil capable of exhibiting flame."

If water be combustible is it not surprising that it has not hitherto been more frequently used as fuel?

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## ON THE RAISING

### OF RED CLOVER SEED. BY EZRA L'HOMMEDIEU, ESQ.

#### NEW YORK AGRICULTURAL SOCIETY.

RED clover seed of late years has become an article of exportation, by which the price has increased, and the production become very profitable to the farmer. More red clover seed is carried to market from Suffolk county than from the whole state besides. It is not uncommon for a farmer in that county to sell thirty bushels of this seed in a year, which in many instances brings him more clear profit than all the rest of the produce of his farm. As the raising of this seed is but very little attended to in other parts of the state, I shall describe the manner of raising it in that county. It grows best on a light sandy soil, on a light loamy soil, or on a soil of light loam mixed with sand; the seed is collected both from the first crop and from the second crop; but the largest quantity is procured from the first crop. By sowing clover seed, three or four pounds to the acre, on light loamy soils (where you sow wheat or rye) which yield eight or ten bushels to the acre, the red clover will not be profitable to mow, but standing thin on the ground, the heads will be well filled with seed; these fields are kept up the next year till the seed is collected; when you perceive about one half of the field to have changed its colour by the drying of the clover heads, you then begin to collect them, which is done by a machine invented at Brookhaven, in Suffolk county. It is drawn by a horse and guided by a man or boy, who will collect from the field by this means, the heads of clover growing on five acres in one day: the price of collecting is two shillings and six pence per acre. This machine is of simple construction; it is nothing more than an open box of about four feet square at the bottom and about two feet high on three sides; one part, which we may call the fore part, is open; on this part is fixed fingers, similar to the fingers of a cradle, about three feet long and so near together as to break off the heads from the clover stocks, which are taken between those fingers; the heads are thrown back into the box as the horse walks on. The box is fixed on an axle-tree, supported by two small wheels of about two feet diameter; two handles are fixed to the box behind, by which the man or boy at the same time he guides the horse, lowers or raises the fingers of the machine so as to take off all the heads from the grass: as often as the box gets full of heads, they are thrown out, and the horse goes on again.

Another instrument is used for collecting hay seed, which is called a cradle. It is made of a piece of oak board of about eighteen inches long and ten broad; about nine inches of this board, which we may call the fore part, is sawed into fingers of about nine inches long; a handle is fixed into the board on the back part, almost at right angles, inclining towards the fingers; a cloth is put round the back part of the board, which is cut rounding, and raised on the handle; this collects or keeps from scattering the heads, which are struck off from the grass by this cradle; different sizes are used, less than the above described, for women and children, who collect large quantities in this way.

On rich lands, ordinarily, no seed is raised from the first crop. If the land is highly manured, or otherwise very good, the first crop of grass is so thick that it yields no seed worth gathering; the second crop being shorter and thinner, is commonly well seeded. Sometimes considerable quantities of seed is gathered from the first crop, on the land where the wheat is cut the same year; the stubble prevents the clover from growing too thick to produce seed.

The second crop of grass on good land is mowed so high as to cut off the heads of the clover, and as little of the grass as possible; a man will mow two or three acres in this manner in a day. The time of mowing is when at least one half of the heads are turned or become dry; it is then raked immediately into small heaps or cocks, of the quantity of about the bigness of a large corn basket.

The machine used for collecting this seed, and drawn by a horse, is seldom made use of in collecting from the second crop: those who do not own a machine, suppose the expense of hiring with the loss of seed trod down by the horse, and levelled with the wheels, being nearly equal to the expense of mowing the second crop.

All the heads of clover, in what manner soever collected, ought to be put into small heaps or cocks in the field, and there exposed, that the husk may rot (which generally takes about three weeks in Suffolk county) otherwise it will be with great difficulty they get out the seed. Some attention ought to be paid to these heaps or cocks, lest they should rot too much next the ground; it will sometimes be necessary in case of much rain to turn the heap; by rubbing the heads in your hand it may easily be perceived when the husk is sufficiently rotten. Whenever it is found the heaps are sufficiently rotted and dry, they are carted into the barn, and whenever it is found convenient the seed is thrashed out on the barn floor, and cleaned with a wire riddle.

The greatest yield I have known was one bushel and four quarts from one quarter of an acre of land—but this produce was extraordinary. This seed is sown in different quantities, according to the richness of the soil, and the use that is proposed to be made of the grass. If seed is to be collected from the first crop, the clover seed is generally sown with wheat on lands which produce from eight to twelve bushels by the acre. The grass on such lands will not be too thick to produce seed from the first crop. Some farmers instead of sowing the clover seed on such grounds at the time of sowing their wheat, sow it the last of February or the first of March. on a light snow. If your land be rich, and you mean to mow the first crop and collect seed from the second, eight pounds is not too much to put on one acre. If this is all sown at the time of sowing the wheat, it may be killed with the winter; if it is not, so much grass commonly injures the crop of wheat; if it is all sown, the last of February or the first of March, and a dry season should follow, while the roots are young and tender, then the crop of grass will be lost. I have found it the safest way, to sow one half the clover seed proposed for an acre, at the time you sow the wheat, and the other half on the same land in the last of the winter or the first of the spring.

Some farmers a little before they cart out their dung from their cow yards, to dung wheat, scatter the heads of clover all over the yard, sufficient to seed the land they propose to dung; the clover heads being trodden into the dung by the cattle, and otherwise mixed by carting out, spreading and ploughing in the dung, the seed comes up exceeding well, and being deeply rooted is not subject to injury by drought or frosts The only objection to this mode is, that the quantity of grass is apt to hurt the crop of wheat.

## OBSERVATONS ON OPIUM,

AND ITS COMPONENT PRINCIPLES; WITH AN ACCOUNT OF VARIOUS PROCESSES FOR OBTAINING IT FROM THE WHITE POPPY. (PAPAVER SOMNIFERUM. LINN.)—BY CITIZEN DURUC, SENIOR.

FROM THE ANNALES DE CHIMIE.

THE natural history of opium does not appear to be hitherto generally well understood. It is doubted whether there exists any drop opium, *(de l'opium en larmes.)* All that seems to be fully established as a fact is, that this singular substance is extracted by the inhabitants of the east from the white somniferous poppy; but the following questions respecting it still remain to be resolved. What are the processes used for obtaining it? What degree of maturity must this plant have arrived at, in order to produce opium such as that of commerce? Finally. Is this vegetable subjected to any particular kind of preparation, before the opium is extracted?

None of these questions have been satisfactorily determined by any of the writers who have treated of this subject.

Several natural historians, and especially Lemery, in his dictionary of simple drugs, asserts positively that *there exists no drop-opium*, and that the opium of the Levant is obtained from the leaves and heads of the poppy. The most celebrated chymists who have treated of the subject, such as Fourcroy, Chaptal, Beaumé, Bouillon-Lagrange, &c. are not agreed amongst themselves, whether it is extracted from the leaves, stalks, and capsules, whilst still fresh and green, or whether it is obtained directly from the heads of the poppy when arrived at its last stage of growth and maturity, by making the extract in the ordinary manner.

This difference of opinion which exists among authors whose knowledge in natural science cannot be called in question, determined me, two years ago, to occupy myself with the investigation of the nature of this substance, by cultivating, with this view, a great number of white poppies. (*Papaver album & somniferum. Linn.*)

But before I give an account of the various experiments which I have made in order to obtain opium, it will be proper that we should establish our opinion concerning two facts relative to this substance, such as it is brought to us from the Levant in the ordinary course of commerce.

It is certain that the oriental opium contains impurities amounting at least to one-fourth of its weight. I have frequently examined these heterogeneous substances, and, after different washings, I have easily discovered, that they were nothing else than the stalks, leaves, feculæ, peduncules, capsules, and seeds of the poppy, in a state of very minute division.

I shall show hereafter that the addition of these substances contributes in a very great degree to give the opium that acrid and nauseous smell which it is known to possess.

It is also known, that this acrid odour is extremely volatile, and that frequently it is not found to exist any longer at the surface of the cakes of opium, whether in consequence of the length of time that they have been kept, or owing to some artificial means that have been employed for that purpose; whilst the lower part of the same cake, which is still viscous, is thoroughly imbued with it, and emits an intolerable smell when cut through the middle; hence it appears, that this volatile principle, or *aroma*, is only an accidental property of the opium.

The following experiments will elucidate what I have advanced, both with respect to the two last mentioned facts, and the solution of the questions which I have proposed at the commencement of this memoir.

Experiment 1. If we dry viscous opium, in a temperature not exceeding 40—50 degrees of Reaumur's thermometer, till it becomes pulverulent, it will lose its acrid narcotick smell, and assume that of laudanum, or the purified opium of the shops, from which it differs only in the impurities which it contains. The vapours which arise from it, when collected in a convenient apparatus, become there in part condensed into a liquid, which at first is almost colourless, but in the space of a few days assumes a slight yellowish tinge. This *aroma*, or distilled spirit, is accompanied by an aeriform fluid, which is not altogether miscible with water, and both diffuse an odour resembling that of opium cakes when cut in half, but so extremely strong as very speedily to suffocate animals exposed to an atmosphere of this gas.

Last year I made the extract of white poppies, gathered at different periods of their growth, without ever having been able to obtain a substance that had the smell of opium, or even that of laudanum. I only perceived that a heap of poppy leaves that had been thrown away, exhaled an aromatick principle very analogous to that which was obtained in the preceding experiment. This led me to make the following experiments.

Experiment 2. On the 3d Prairial (22d May) last, twelve leaves of the white poppy, which had attained to one third of their full growth, were well pounded in a marble mortar, without adding any liquid. The juice was very abundant, of a brown colour, slightly mucilaginous, and had but little of a bitter taste. The whole was put into a vessel of stone ware, and exposed to the atmosphere. The temperature of the atmosphere was between 10 and 12 degrees Reaum.

On the 4th I observed a slight swelling in the mass. On the morning of the 5th it puffed up prodigiously, and already exhaled an acrid odour, very similar to that of the aroma obtained by the desiccation of the opium. On the 6th, the vapour was exhaled in such large quantity, that it was impossible to approach it without becoming affected with a violent headach. On the 7th, I exposed the vessel to the sun for a space of twelve hours. The fermentation became still more vehement: I agitated the mass from time to time, attending to what happened.

I soon perceived that the exhalation of the narcotick odour abated, and was partly replaced by another, which had much analogy with azotick gas; the plant and the juice acquired a deeper colour; at length they became oxydated at the expense of the surrounding air, which probably gave birth to the nitrick radical, which, combined with the aroma of the plant, produced that peculiar odour of which I have been speaking.

Experiment 3. On the 24th of the same month, twelve pounds of poppy, that had arrived at about three-fourths of its growth, after having been prepared like those in the preceding experiment, were also exposed in a vessel to the air. On the 26th, the mass began to ferment, and the acrid narcotick vapour was developed in a very perceptible manner; but this time I did not expose the mass to the sun. On the 28th the smell peculiar to opium was very perceptible: I then pressed out the juice, filtrated it cold, and evaporated it, with a very moderate heat, to the consistence of an extract.

I thought I had the best grounds to expect that I should obtain real opium as the result of this experiment; but I was disappointed; for, in proportion as the juice gradually thickened, it lost its narcotick odour, and the extract which I obtained had no other smell than that peculiar to the extract obtained from inodorus plants: hence I drew the further conclusion, that this aroma was of the same nature as that obtained in experiment 1.

Experiment 4. On the 14th of Messidor (2d July) following, I expressed two pounds of juice from poppies partly in bloom, and partly ready to blossom. This juice was of a dirty yellow colour, nearly resembling that of the *Chelidonium majus;* it had a very slight smell of laudanum, and a marked bitterness, and left a very considerable roughness upon the tongue. I exposed it to the air in a vessel of earthen ware, in which it fermented rapidly, so that, on the 17th, it exhaled an odour similar to that of the opium of Egypt. This juice I filtrated cold, and, hoping to preserve its odour, I thickened it by exposing it in plates to the heat of the sun. The extract which I obtained still resembled that of the preceding experiment.

Experiment 5. On the the 19th Messidor, I extracted about one kilogramme of the juice of poppy heads, partly in flower, and partly after the leaves had fallen off, and the capsules had become very large. This juice was more bitter than that obtained in the preceding experiments. I reduced it to one half of its quantity by the application of a very gentle heat, hoping that the mass being more dense, and its particles in closer contact with each other, I should obtain, after fermentation, a substance whose odorous principles would be more coercible.

The juice thus inspissated did not begin to ferment till the 25th, though the heat of the atmosphere was greater than during the preceding experiments. On the 30th it had the desired odour, and the experiment seemed very promising.

Again I was disappointed. I reduced half of the mass to an extract, which perfectly resembled that obtained in experiment 3 and 4: the other half I kept in a well corked cask, to be used in another experiment.

Experiment 6. On the 28th of Messidor, four hectogrammes of capsules, sufficiently green, but arrived at their full size, and twelve decagrammes of the leaves and stalks pulled off near to the peduncle of the plant, were well bruised and pounded in a mortar. They yielded a thick viscous mass, and the juice was deeper coloured, and more bitter than that obtained in the preceding experiments. The whole being exposed to the air in an earthen vessel, it soon fermented, and four days were sufficient to produce the evolution of an odour like that of the true oriental opium.

Of this mass I preserved one part, to be used afterwards, and inspissated the other in a temperature not exceeding 40 degrees. This extract retained a very slight smell of laudanum: it was a mixture nearly similar to the opium of commerce, excepting that the aroma had been evaporated by the heat.

It would be superfluous to describe here the numerous experiments which followed the two lastmentioned: the result in each of them was an inodorous extract, or one almost so, It is, however, proper to observe, that the pounded leaves, stalks, capsules, &c. of the poppies, always exhaled, after fermenting, for a longer or shorter period, the narcotick odour, or that of the aroma, obtained in experiment 1, but they lost it again after being exposed ten or twelve days to the air.

Before I proceed to relate other experiments, I ought to mention several remarks which I have made upon poppies, from the period at which they blossom till that when the capsule begins to grow yellow, after which they exude no more juice.

During a period of fifteen days, I made incisions, both upon the peduncule and upon the lower part of a great number of very fine poppy heads, from whence there issued a whitish yellow juice, almost inodorous, but very bitter, which filled up the incision, and assumed a blackish colour in a very short space of time: its taste was not changed by exposure to the air, but it first acquired the acrid odour, which, in the preceding experiments, was developed by fermentation: this, however, was soon evaporated by exposure to the sun, and the juice retained only that of laudanum.

I also remarked in my bed of poppies, that some of the capsules were of a form almost entirely spherical, whilst others affected the oval figure.

The first naturally produced opium without any incision being made into them. This juice collected itself in two, three, and sometimes four sutures, which are found in the peduncule, where it concretes, and in a very short time acquires the smell and colour of laudanum. I have collected small masses of it, some of which weighed eight grains. I took two grains of this opium, which procured me a very tranquil and protracted sleep. *This was drop-opium.*

All these poppies were sowed on the 10th of Germinal last, (March 30,) in a very rich and well manured soil, defended against north and north-east winds, by a building and a wall. The finest plants were at the disdistance of a foot from each other.

Nature having completed her work, I imagined also, according to the result of experiment 6, that it would be possible for me to attain my object, and make opium with poppies arrived at their last degree of maturity.

Experiment 7. For this purpose I took twelve fine poppy heads, six of which were oval and six globular. I pounded them together with their seeds, with twenty-four decagrammes of rain water. Having exposed them to the air, in an earthen vessel, I was very much surprised, four days afterwards, to observe spots of mould upon them. I repeatedly stirred the whole mass, but none of the phenomena of the preceding experiments took place: the mass, left to itself, was destroyed in the manner usual with all vegetables.

Experiment 8. I made an extract, according to the usual method, (by decoction) from a considerable quantity of poppies. The decoction was saturated, and became slightly mucilaginous as it cooled, without however emitting any thing of the odour either of opium or of laudanum. I gave the extract a pulverulent consistence: it differed essentially from those of the inodorous plants, possessing a degree of cohesion which is not usual with those, and which I attributed to the resin contained in it, &c.

Experiment 9. A portion of the dried extract obtained in the preceding experiment was well triturated with a sufficient quantity of the viscous residuum that had been laid by in experiment 5, in order to obtain a mass having the same consistence as the opium of commerce. This mixture much resembled the laudanum of the shops in colour, taste, and smell.

Experiment 10. The other portion of the extract obtained in experiment 8, was likewise reduced to the consistence of opium with the residuum that had been laid by in experiment 6. Three days after its formation, this mass might, by its impurities, viscidity, colour and taste, have been confounded with the opium of the Levant, excepting that it was not wrapped, and in some measure kneaded with poppy leaves.*

To sum up the results of my observations, I am induced by the experiments above related, to believe:

1. That the opium of commerce is not merely the extract or inspissated juice of the stalks, leaves, or green capsules of the poppies; for, were that the case, it would not contain so large a quantity of impurities, which are distributed in an almost uniform manner throughout the whole mass.

2. That this same juice or extract, if prepared with the intervention of heat, however moderate, would not have the acrid nauseous odour, which the oriental opium retains as long as it preserves its viscidity, as is demonstrated by experiments 3, 4, 5, and even 6.

3. That the opium of the East is not the mere extract prepared by the infusion or decoction of the heads of the white poppy after it arrives at the stage of maturity; since that which was obtained by experiment 8, was by no means odorous, and was also exempt from impurities.

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* I have observed that poppy leaves, when half dry, contract the narcotick smell, which leads me to believe, that they are used in the East, thus prepared, for wrapping the cakes of opium in them.

I should add, that I have had in my possession capsules of the white poppy of Egypt, between which and those cultivated in France there appeared to me to be no difference.

4. That it appears to be made out by experiments 9 and 10, that the opium of the East is the inspissated extract of every kind of the white poppies, gathered from the time when they begin to flower till they have arrived at maturity, and afterwards mixed together, and reduced to the consistence which is observed in the acrid odorous mass, obtained from the stalks, leaves, and green capsules, of the same kind of poppies, pounded and fermented till the moment when the acrid nauseous odour is evolved as appears by the result of the above mentioned experiments, and particularly experiment 6; and, finally, that this mass is divided into cakes, which are wrapped and kneaded at their surface with poppy leaves, in part dried, and thus sent to foreign nations.

5. That it appears, by the observations inserted between experiments 6 and 7, that there does really exist drop opium, and that the substance which is thus termed by some natural historians, naturally exudes from that variety of the white poppy, the capsules of which affect the spherical form.

This opium differs from that of commerce by its being almost entirely soluble in water, by its purity, by its taste, which is less bitter and acrid than that of the latter, and by its odour, which is less narcotick and nauseous.

This invesigation is not so complete as might be wished; and I am well aware of numerous objections that might be made against what I have advanced, such as the analysis of my opium compared with that of commerce, its medicinal qualities, &c. &c. I have not the vanity to imagine that I have completed the work which I have undertaken, but its deficiencies may still be supplied. I did not think it necessary to enlarge upon the medicinal virtues of this substance. This part of the investigation is the province of the medical writer: I only assert that the drop opium which I obtained produced a perfect tranquillity in the system, without occasioning vertigo.

However, I do not doubt the possibility of procuring good opium from poppies cultivated in the temperate zone; and the reader is also requested to observe that those upon which I made my experiments were raised in one of the northern departments in France. I wish that the same experiments might be repeated with poppies raised in the south of the Republick. I keep a considerable number both of the spherical and oval kind, and shall with pleasure procure them for any person who may be inclined to occupy himself with this kind of labour, and to bring to perfection a work of which I have only sketched the outlines. When this shall be accomplished, we shall cease to be tributary to the foreign nations who sell us this substance at a very high price.

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## ON THE CULTURE OF OPIUM.

FROM THE ANNALS OF MEDICINE FOR 1796.

AMONG the premiums given by the Society in London for the encouragement of arts, manufactures, and commerce, for the year 1796, is one of fifty guineas to Mr. John Ball of Williton, for the discovery of his method of preparing English opium. The opium is attested by several physicians who have made trial of it, and whose letters are inserted, to be at least equal in efficacy in the same dose to foreign opium. Mr. Ball in one of his letters in the correspondence with the society on this subject, asserts that he has no doubt that the opium which he prepares from poppies in his own garden, may be afforded at half the price of foreign opium: for that, in a few years we shall be able to render it from five to eight shillings per pound, without the least adulteration. And I am of opinion, says he, that the more barren ground, which, in some places lets at from two to ten shillings an acre, will, with very little expense answer for the growth of poppies. I shall take care, this summer, to find out whether any particular sort or colour produces the most opium.

We shall give the letter entire, which contains the method of preparing the English opium.

*My Lords and Gentlemen,*

By your secretary Mr. Moore, I received your resolutions respecting your purchasing from me the mode of my preparing the sample of opium, which I took the liberty of sending to you, and at the same time, to beg the favour of your having a sufficient trial of its properties, which I find you have been so obliging as to have done, and likewise to have granted me the fifty guineas, as purchase of my method of preparing opium, for which you have my sincere thanks. I am exceedingly pleased to find, that it was thought worthy of the notice of so honourable and reputable a society; and I am satisfied there can be no other mode of preparing or collecting the pure and genuine opium than what follows:

Nothing can be more simple, or attended with less expense, than the making or extracting the pure and genuine opium from the large poppies, commonly called or known by the name of garden poppies, the seeds of which I would advise to be sown the latter end of February, and again about the second week in March, in beds about three feet and a half wide, well prepared with good rotten dung, and afterwards turned and ploughed, in order to mix it well, and have it fine, either in small drills, three in each bed, in the manner sallads are sown, and when about two inches high, to thin them one foot apart; or otherwise to rear them in beds in the broad cast way, and thin them to the same distance; and if the weather should prove wet at that time, those that are taken up may be transplanted; but I do not suppose that the transplanted ones will answer, as they have but one root, and require frequent waterings. Keep them free from weeds, they will grow well, and produce from four to ten heads, showing large and different coloured flowers, which, when the leaves die away and drop off, the pods then being in a green state, is the proper time for extracting the opium, by making four large longitudinal incisions, with a sharp pointed knife, about an inch long, on one side only of the seed-pod, just through the scarf-skin, taking care not to cut to the seeds. Immediately, on the incision being made, a milky fluid will issue out, which is the opium, and being of a glutinous nature or substance it will adhere to the bottom of the incision; but some are so luxurient, that it will drop from the pod on the leaves underneath. The next day, if the weather should be fine and a good deal of sunshine, the opium will be found, a greyish substance, and some almost turning black. It is then to be scraped off the pods, and if any, from the leaves, with the edge of a knife, or an instrument for that purpose, into pans or pots; and in a day or two it will be of a consistence to make into a mass, and to be potted.

As soon as you have taken away all the opium from one side of the pod, then make incisions on the opposite side, and proceed in the same manner. The reason of my not making incisions all around at first is, that you cannot so conveniently take away the opium; but every person, upon trial will be the best judge.

Children may with ease be soon taught to make the incisions, and to take off the opium; so that the expense will be found exceedingly trifling. The small white seeds in that state will be found very sweet and pleasant, and may be eaten without the least danger; and it is the custom in the east to carry a plate of them to the table, after dinner, with other fruits.

I intend, this year, to keep apart a small quantity of opium from each coloured poppy, to find out it any one, more than another, produces a greater quantity or of greater strength, and shall save seeds of each to sow separately the next spring. I am of opinion that numbers of inclosures taken from hills in a south aspect with a very little expense, may be brought into a proper state for the growth of poppies.

I should think that an instrument may be made, of a concave form, with four or five pointed lancets, about the twelfth or fourteenth of an inch, to make the incisions at once; and likewise something of the rake kind, so that three drills, which I have directed to be made in each bed may be performed at the same time.

By a calculation which I have made, supposing one poppy growing in one square foot of earth, and producing one grain of opium, more than fifty pounds will be collected from one statute acre of land; but upon recollecting, that one poppy produces from three or four to ten heads, and, in each head from six to ten incisions are made, and I am positive from many of them (I mean one incision) the last year, I took away two or three grains; what must then be the produce? Opium is now twenty-two shillings the pound.

I am, &c.

(Signed) JOHN BALL.

Williton, 2d June, 1795.

In a subsequent letter, Mr. Ball states, that the experiment of transplanting did not succeed, not one plant coming to perfection. The pods should be about the size of a walnut before the incision is made. The dried heads from London, being three times as big, must afford much more opium.

In another subsequent letter, Mr. Ball informs the Society, that double, or semi-double poppies gave more than twice what is collected from the single. One poppy, which had twenty eight heads, afforded above thirty grains of opium. It was of a semi-double kind, and the opium was of better quality than from single heads. The article closes with letters of testimonies, namely, from Dr. Latham, Dr. Pearson, and Mr. G. Wilson of Covent Garden, who all agree, that the English is at least equal in efficacy, to the best foreign opium.

# EXPERIMENTS

## ON THE CULTIVATION OF THE POPPY PLANT, AND THE METHOD OF PROCURING OPIUM, &C. BY DR. SHADRACH RICKETSON, OF DUTCHESS COUNTY, NEW YORK.

FROM THE AMERICAN MAGAZINE PUBLISHED IN NEW YORK.

OPIUM is the produce of the *papaver somniferum* of Linnæus, which, as a *genus* comprehends two species, viz. 1. The double ; 2. The single ; each of which includes several varieties as to the colour of the flowers, some being white, some red, others purple and variegated.

From history we are told, that in the several provinces of Asia, it is the large white poppy only that is cultivated for the purpose of collecting opium ; but from the trials I have made, I am of opinion that it is a matter of indifference which species or variety of the plant is cultivated for medicinal use, as they all afford, when tapped, a juice that is similar as to quantity, colour, and every other respect, both fresh, and when dried ; however, I have thought that the large double species produces the greatest number of heads, and consequently the greatest quantity of juice from one seed ; but of this I have not yet had sufficient trials to be certain.

Among the poppies cultivated with a view to make the present experiments, I had some that had thirty heads apiece, all of which sprung from one seed, and from one original stock.

The poppy seeds in this country should be sown or planted about the middle of May, in rich, moist ground.

The ground should be formed into areas of about four feet in width. The seeds should be planted at about ten or twelve inches distance in transverse rows, which should always be about the same distance from each other.

Shallow holes, of an inch depth should be made in the rows at the distance mentioned ; the seeds put in, and covered over even with the ground ; after which they are suffered to remain till the plants are grown about four inches high, when, especially if the land is dry and not fertile, they may be frequently watered and manured, the best for which last purpose is said to be a compost of ashes, dung, and a nitrous earth.

They are said in the East-Indies to water them again profusely just before the flowers appear ; but as I have had them grow very luxuriant and succulent in good ground, without either manuring or watering, I am disposed to think that the advantages arising from this last particular are not equal to the trouble of doing it.

It is scarcely necessary to remark that the plants, at their first coming up should be kept clean from weeds and the like, which may be done with very little trouble with a small hoe, especially if the seeds are planted after the manner I directed, that is, in rows.

Having said all that is necessary on the cultivation of the plant, I shall now proceed to describe the method of obtaining its juice, which, when inspissated to a pilular consistence is called opium.

The states of the plants wherein I have found them to yield most juice, are just before, in the time of, and immediately after flowering, the plants being arrived to one or the other of the states above mentioned.

We then proceed to that part of the process called tapping, which we are told is done in Asia, by making two or three longitudinal incisions in the half grown capsules, without penetrating their cavities at sunset, and the plants suffered to remain till morning, when the juice is to be scraped off and worked in a proper vessel, in a moderate heat till it becomes of a pilular consistence: which method with several others I have tried, but none have succeeded so well with me as, in a sunshining day, to cut of the stocks at about an inch distance from their flowers or capsules, and as soon as the juice appears, which it does at first equally well on the part of the stalk cut off with the capsule or flower as on the standing part, to collect it with a small scoop or penknife, the last of which I have found to answer the purpose very well. After the juice ceases to appear on the top of the standing stalk, it should be cut off about an inch lower, when it will be found to yield almost as freely as before, and repeated as long as the juice appears.

The juice, when, collected should be put into an evaporating pan, placed in the sun's heat, and frequently stirred till it becomes of a consistence to form into pills, or made into rolls, for keeping or transportation.

The quantity of opium that may be procured, depends very much upon the largeness of our plants, and the care used in collecting it.

## REMARK BY T. G. F.

There is perhaps no article of culture which presents more alluring prospects to the industrious farmer, than that of the poppy. The opium may be collected by women and children, and it would be a very poor crop indeed which did not amount to 50 lb. an acre. The present price of opium (March 1808) in Philadelphia is fourteen dollars. An acre of land then, on the most moderate calculation will produce opium to the value of 700 dollars, provided this article should continue at the present price; and even allowing it to fall one half the profits arising from this species of culture would still be very great.

## SPECIFICATION

OF THE PATENT GRANTED TO JONATHAN WOODHOUSE, OF ASHBY-DE-LA-ZOUCH, IN THE COUNTY OF LEICESTER, CIVIL ENGINEER; FOR A NEW METHOD OF FORMING A CAST-IRON RAIL, OR PLATE, WHICH MAY BE USED IN MAKING IRON RAIL ROADS, OR TRAYS, FOR THE WORKING AND RUNNING OF WAGGONS, DRAYS, AND OTHER CARRIAGES, ON PUBLICK AND OTHER ROADS; AND ALSO, A NEW METHOD OF FIXING, FASTENING, AND SECURING, SUCH CAST-IRON RAIL OR PLATE, ON SUCH ROADS. DATED FEBRUARY 28, 1803.

WITH A PLATE.

TO all to whom these presents shall come, &c. Now know ye, that the said Jonathan Woodhouse, in and by this his instrument in writing, under his hand and seal, pursuant to, and in compliance with, the terms of the said in part recited proviso, doth hereby declare, that the said invention is described in manner following; that is to say: The rail or plate is made of cast iron, and the upper part or surface thereof is concave: the width of which rail or plate may be increased or diminished as may best suit the size of the wheels of the carriages that may be worked upon the particular roads where the rails or plates are used. The method of fixing, fastening, and securing the cast iron rails or plates is to place them on bearings, at convenient distances, which are to be fixed firm and solid in the earth, and to fasten the rails or plates to such bearings with wrought-iron screws, or cutter bolts. The bearings for the rails or plates may be made of timber, stone, cast-iron, or wood-piles; and if the rails or plates are properly fixed to such bearings with wrought-iron screws, or cutter bolts, and the road is made even with the surface of the external or outer edges of the rails or plates either with stone, gravel, or wood, or any other road materials, the rails or plates will be immovable, and the wheels of the carriages used thereon will pass over the same with facility; and, by reason of the concave form and manner of fixing of the said rails or plates, no shock which they can receive (except some wilful force is maliciously used) can injure or break them. Those rails or plates may be used on private as well as on publick or other roads, with a great advantage where a multiplicity of business is to be carried on; and by reason of such the concave form, and manner of fixing them, they admit of the wheels of carriages to get upon, or from them, with facility in any direction. And the wheels working on those rails will move with great smoothness and ease. The above or annexed plans or drawings show the cast iron rails or plates (see plate II. fig. 3.) and the method of fixing, fastening, and securing them, of which the following are the explanations. The plans or drawings, numbered 1, show the upper surface of the rails or plates upon which the different carriage wheels are intended to run. The drawings numbered 2. show the elevation or end view of the plates or rails, and their form at the ends and sides, and how they are fixed to the bearings. The drawings numbered 3, show the side view of the rails with the bearings under them. The parts in which drawings marked *a*, *a*, *a*, *a*, show the ends of the feet, or the bases of the metal which rest on the bearings. And the letters *b*, *b*, *b*, *b*, *b*, on the drawings numbered 2 and 3, show the bearings upon which the aforesaid bases or feet rest. The drawings or sections, numbered 4, show the section of the base or underside of the rails as at *c c*, *c c*, *c c*, *c c*, *c c*, *c c*. These recesses are purposely made to receive the wrought-iron screws or cutter bolts, which serve the double purpose of preserving and securing the cast-iron rails or plates in a direct line with each other, and of firmly securing them on their respective bearings. *d*, *d*, *d*, *d*, in the same drawings or sections, show the stays cast between the sides of the rails or plates, which brace them together at the bottom edges. The drawings or sections of the plate numbered 5, show the upper surface of a diced or chequered rail or plate, which will be convenient and proper to be laid in sheets, and where roads meet or cross each other, as they will prevent the horses feet from slipping, and will therefore be more particularly useful in such roads or shoots as have a declivity or descent. The two drawings numbered 6, show the surface of the iron rails or plates when fixed in a road or street, where the road or street is paved with stone. The two drawings numbered 7, show the iron-rails in a publick or common road, made with the usual materials of gravel and stone, or other road materials, with this difference, that with a view to keep the rail or plate as free from gravel, sand, and other things as possible, a course of stones is placed on each side of the rail or plate, but which may be used or not, as is found most convenient. And the said Jonathan Woodhouse doth hereby declare and affirm that the particulars, above set forth, do contain a full, true, and perfect description of the nature of the said invention. In witness whereof, &c.

## REMARKS ON THE ADVANTAGES OF CONCAVE IRON ROADS. BY THE PATENTEE.

Two horses would on this road convey a mail coach more than eight miles per hour as easy as the present mails are conveyed six miles per hour by four horses. The conveyance would be so easy that gentlemen might read nearly as well as on board a ship: The even and compact manner in which this road would be laid, would render it the safest of all others, with the additional advantage of using wheels of any diameter. As this road might be kept constantly moist it would have a singular advantage over other iron roads, in keeping the metal perfectly cool, and consequently less friction and wear. It has ever been an object in the projection of canals to bring them as near towns as possible, when, after all, a cartage, or removal, must take place. In bringing a canal near a large town the difficulties and inconveniences are very great, valuable property is wasted, communication (which is very essential) is cut off, the situation for the business is limited, no further extension can take place; even this may be in a situation where there is an embankment, of course inconvenient to load in and out, or if deep cuttings, the wharfs are then expensive in excavating. This rail way would waste valuable land near a large town in a trifling comparative degree to a canal, communication would be free, on and over every part of the same; nor would there be any particular limited situation for wharfs or warehouses: hence large towns would derive benefit in every part near which the road would be extended, carriages would not be liable to break down, nor would the wear of tiers, or any part, be put out of order by violent shocks. The easy repairs of carriages on such a road will certainly bear no comparison to those on common roads. The iron rail-ways in use, wherever they are upon and cross a turnpike road, are inconvenient: these, on the contrary, form not the least impediment.

# ACCOUNT

## OF THE PENRHYN IRON RAILWAY. COMMUNICATED BY THE INVENTOR, MR. BENJAMIN WYATT, OF LIME GROVE, NEAR BANGOR.

REPERTORY OF ARTS.

THE following account of the Penrhyn railway, with the section of the rail, will, I flatter myself, be acceptable to many of your readers. The rail hitherto made use of in most railways is a flat one, three feet in length, with a rib on one edge, to give it strength, and to prevent the wheels (which have a flat rim) from running off. Observing that these rails were frequently obstructed by stones and dirt lodged upon them; that they were obliged to be fastened to single stones or blocks on account of their not rising sufficiently high above the sills, to admit of gravelling the horse-path; that the sharp rib standing up was dangerous for the horses; that the strength of the rail was applied the wrong way; and that less surface would create less friction; led me to consider if some better form of rail could not be applied; the oval presented itself as the best adapted to correct all the faults of the flat rail, and I have the satisfaction to say that it has completely answered the purpose in a railway lately executed for Lord Penrhyn, from his lordship's slate-quarries, in Carnarvonshire, to Port Penrhyn (the place of shipping.) The wheel made use of on this rail has a concave rim, so contrived in its form, and the wheels so fixed upon their axis, as to move with the greatest facility in the sharpest curves that can be required. It is plain, by inspecting the section of this rail (see plate II. fig.4.) that no dirt can lodge upon it; that it must be stronger than any other form of the same weight, to resist both the perpendicular and lateral pressure; that it must occasion very little friction; that it presents no danger to the horse; and that it may be placed upon the sills, so as to admit of a sufficient quantity of gravel to cover them. These advantages have so forcibly struck all who have seen and examined this road, that I have been induced to lay it before the publick through the medium of the Repertory of Arts and Manufactures.

The Penrhyn railway is six miles and a quarter in length, divided into five stages. It has three-eighths of an inch fall in a yard, with three inclines was begun in October 1800, and finished in July 1801.

On this railway two horses will draw twenty-four wagons one stage six times a day, and carry twenty-four tons each journey, which is 144 tons per day. This quantity used to employ 144 carts and 400 horses; so that ten horses will, by means of this railway, do the work of four hundred.

I am, &c.

BENJAMIN WYATT.

REFERENCES TO PLATE II.

Fig. 4, shows the kind of carts used on this railway.

Fig. 5, section of the railway, full size, four feet six inches long; weight thirty-six pounds. The part below the oval is cast to each end of the rail three inches long, to let into the sills, which have dove-tail notches to receive them.

## REMARK BY T. G. F.

The preceding articles we hope will meet with particular investigation from gentlemen who propose to embark property in cutting canals, and making locks to falls in our navigable rivers. If the advantages attending these railways are equal to what is here represented they ought in most cases to supercede canal and lock navigation.

# SUBSTITUTE FOR VERDIGRIS.

FROM THE TRANSACTIONS OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE.

THE silver medal and ten guineas were given to Mr. Clagg, for his discovery of a substitute for verdigris, in dying black, of which the following is an account, drawn up by himself.

Many articles which are in daily use, both in dying and other arts, have been found by chance to be necessary, yet sufficient pains have not been taken to ascertain the principles upon which they act: of this number is verdigris;* and as this article was imported to us at a very great expense from France, I was induced, some years ago, to undertake a course of experiments to investigate the manner of its operation, and from thence to find, if possible, an effectual substitute, cheaper and nearer home. On adding verdigris to the common ingredients of the black die (viz. astringents and martial vitriol†) the first thing remarkable is that a quantity of iron is precipitated; for the pieces of verdigris will be covered over with the crocus of iron, almost instantly, and a quantity of the copper of the verdigris is at the same time taken up by the disengaged acid; as appears by the copper coat a knife receives on being held in the liquor; so that the vitriolick acid leaves the iron, with which it was combined in martial vitriol, and unites with the copper of verdigris, and again leaves the copper to unite with iron in its metallick state. The same decomposition happens with lead, if *saccharum saturni* be made use of instead of verdigris, though lead, according to the received doctrine of elective attractions, has a still less affinity with iron than copper has. In fact, I find that *saccharum saturni* will answer nearly the end of verdigris, and though as a substitute to it we could reap no advantage from it, yet I think it gives us an insight into the principle upon which verdigris is of

* Acetate of Copper. † Sulphate of Iron.

use in the black die, viz. by uniting with part of the acid of the vitriol, and giving the astringent matter of the vegetable an opportunity of forming an ink with the precipitated iron in greater abundance, and more expeditiously than it could otherwise do. Believing this to be the true manner of its operation, I went to work upon this principle, and substituted *alkaline salts* in the room of verdigris, as I imagined these would be a much more innocent as well as cheaper ingredient; for the acid or the corrosive metallick salts are the only hurtful ingredients in the die, and the alkali in proper proportion will unite with the subordinate acid, and form an innocent neutral salt, *vitriolated tartar*. Upon the first trials, I was satisfied of the truth of my conjectures; for in all the experiments which I made in the small way, the ashes answered at least as well as the verdigris: but in real practice in the large, I found myself deceived; for upon dying a kettle of hats of twenty-four dozen, though the colour came on surprisingly at first, yet the liquor soon became weak. I made many experiments, which it is useless here to relate, until I united vitriol of copper with the alkali, which upon repeated trials, has been found to answer perfectly the end of verdigris. The following, I believe will be found the just proportions, though there is some difference in the practice of different die houses.

Saturate two pounds of vitriol of copper, with strong solution of alkaline salts (American potashes, when to be procured are recommended.) The vitriol will take about an equal weight of dry ashes. Both the vitriol and the ashes are to be previously dissolved apart. When this proportion is mixed, well stirred, and suffered to stand a few hours, a precipitate will subside. Upon adding a few drops of the solution of ashes, if the mixture be saturated, the water on the top of the vessel will remain colourless; but if not, a blue colour will be produced, upon which add more ashes; there is no danger of its being a little over saturated with ashes. Take care to add the solution of ashes to that of vitriol by a little at a time, otherwise the efflorescence which ensues will cause them to overflow the vessel; these four pounds of vitriol of copper and ashes, will be equal to about the same weight of verdigris; and should be added to the other liquors of the die at different times, as is usual with verdigris.

The black, thus died will be perfectly innocent to the goods, rather tending to keep them soft, than corrode them, particularly hats, in which there is the greatest consumption of verdigris.

For those who are constantly using verdigris, it would be proper to have a vessel always at hand, containing a saturated solution of vitriol of copper, and another with a saturated solution of ashes, ready to mix as they are wanted; for I find they do not answer so well if long kept.

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## AN ESSAY

### ON THE EXPRESSING OF OIL, FROM SUN-FLOWER SEED, &C. BY DR. J. MORGAN.

TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE grinding of the sun-flower seeds, and expressing of oil from the same, is a manufacture, which, as far as can be yet learned, was first begun among the Moravian brethren at Bethlehem, and reflects honour upon them, whilst it affords the publick a new substance very beneficial in a variety of purposes, but more especially, as it may serve for a sallad oil, and for other uses of diet and medicine, in the place of olive oil.

From experiments already made at Bethlehem, it is found that a bushel of the sun-flower seed will yield, on expression, near a gallon of mild oil. The gentleman, who is appointed by the community there to superintend their mills, designs, as we are informed, to pursue a further course of experiments on this subject, the result of which, we hope, will be communicated to this society.

Our correspondent at Lancaster informs the society, that some persons in the neighbourhood of that place, have also expressed a quantity of oil from the seeds of the sun-flower. His account is as follows.

" The person, who has raised the greatest quantity of the sun-flowers with us, informs me, that one hundred plants, set about three feet distance from each other, in the same manner Indian corn is commonly planted will produce one bushel of seed, without any other trouble, than that of putting the seed into the ground, from which he thinks one gallon of oil may be made. I observed the land, on which he planted the sun-flowers, to be of the middling sort, and that he took no pains to hill them, or even to loosen the ground about them, which from my own observation on some planted in a neighbour's garden, I take to be of considerable use.

"As the sun-flower is a plant of great increase, and requires much nourishment, hilling does not seem so good a method as that of setting the seed or plant in a hole, and when the plant is about a yard high, to throw in the mould round the stalk, so that the surface of the ground may be even about it. By an estimate made it appears, that one acre of land will yield to the planter between forty and fifty bushels of seed, which will produce as many gallons of oil. The process for making or extracting the oil is the same as that of making linseed oil, which I make no doubt the Society is acquainted with, and therefore shall not trouble you with it."

The success attending the trials already made, give the greatest encouragement to prosecute this useful discovery. And as the seeds of the sun-flower are at this time nearly ripe, and in a proper state for extracting the oil from them, it may be of service to lay these facts before the publick. Such as may have an inclination to make trials on this subject, and are not at present furnished with a sufficient quantity of seed for pressing out an oil, may now supply themselves with enough to plant for making experiments the ensuing year.

For the information of those who have both opportunity and inclination to extend the inquiry, and render this a valuable branch of business, but are not acquainted with the general principles upon which oil is obtained, by expression from vegetable substances, it may be proper to observe that the kernels of fruits, such as walnuts, hickory nuts, filberts, almonds, peaches, &c. and the seeds of many plants, as mustard, rape, poppy, flax, sun-flower, &c. contain a large portion of mild oil. In order to obtain the oil, the kernels or seeds are commonly rubbed to powder, or ground in mills. They are then put into a strong bag, made of canvas or woollen cloth, and committed to a press between iron plates, by which the oil is squeezed out, and is received or conducted into a proper vessel to collect it. The plates of the press are often heated, either in boiling water or before the fire. Many heat the mash itself in a large iron pot, stirring it about with a stick or piece of wood, to prevent its burning, which, when it happens, greatly injures the oil, and gives it a burnt smell and taste, or disposes it to become rancid in a short time. When the oil is drawn without the assistance of heat, it is known by the name of cold drawn oil, and is more valuable, than when heat is used, but it is not obtained in the same quantity. It is milder, and may be kept longer without spoiling.

In a cold season of the year, a certain degree of heat is absolutely necessary. But if the oil is designed for aliment or medicine, the plates of the press should be heated in boiling water only. When the oil is intended for other uses, the plates may be made hotter, as heat expedites the separation of the oil, and gives a greater produce, but then care should be taken not to injure the subject by burning.

Sometimes the subject, when ground, appears almost like a dry powder. It is then said to be meagre, and requires to be exposed to the vapours of boiling water, which is done either by tying it up in a bag, or putting it into a sieve, and placing it over the steam. By this impregnation, it will yield its oil more readily, and in greater quantity. The oil may be easily freed from any water that may happen to be pressed out with it, as a spontaneous separation between them will take place on standing for some time.

For the encouragement of those who may choose to improve this subject, it may be proper to observe, that all the oils, from whatever vegetable substances they are drawn, when obtained by expression with due caution, agree in their general qualities, and are constantly mild, even though they are obtained from very acrid substances. Thus the expressed oil of mustard seed is when fresh, as mild as that of olives, and the bitter almond, or peach kernel, affords an oil, by expression, as mild as that of sweet almonds. It is upon this principle, that the sun-flower oil may prove equally valuable with the best Florence oil, for diet or medicine. For every expressed oil, when pure and fresh, is void of acrimony, and free from any particular taste or smell.

Besides the mild oil just mentioned, some substances contain another kind of oil, called its essential oil, a part of which may be drawn off with the mild expressed oil, so called, and impart its smell or taste to that oil. It is called essential oil, from its yielding the particular odour of the vegetable, or part of the plant, from which it was obtained; it is pungent to the taste, and soluble in spirits of wine, which the other is not. They may, therefore, be easily distinguished from each other.

The oil of sweet almonds, and the oil of olives, being pure unctuous expressed oils, not soluble in spirits of wine, but mild to the taste, and void of odour, very soft, emollient and lenitive, are chiefly used in medicine and diet. And the reason why the oil of olives, in particular, is preferred, is because it is less expensive, and will keep a much longer time without becoming rancid.

Perhaps, on trial, the sun-flower seeds may be found to contain an oil that will answer the like good purposes with the sallad and medicinal oil now in use. If so, it will have this advantage over that of almonds or olives, that it is a native of the country, may be always had fresh, and at a small expense. Whereas the others are the produce of distant countries, bear a high price, and are often adulterated on that account; or being kept a long time, they lose their mild quality, and become rancid and acrimonious.

The practicableness of getting oil among ourselves at a moderate expense, and the importance of using it fresh, together with the probable uses of sun-flower oil for varnishes, for the basis of ointments, and for mixing of paints, as well as other purposes to be answered by oils in general, claim our attention to this subject, and encourage further trials of the like kind.

Before we quit this subject, it may not be amiss to mention, that castor oil is justly celebrated for its medicinal qualities. The plant, from the seeds of which it is got, may be easily cultivated in this country, and the increase of it is very great in a short time; might it not then be worth the attention of our farmers to propagate this plant for the sake of its oil? We would just suggest, that perhaps it might be worth while to try whether the seeds of sumach, with which this country abounds, or of the mullein, which grows in old fields, and bears a great quantity of seed, would not yield by expression, a valuable oil for medicine or other purposes.

# LETTER

OF MR. JOHN MOREL, TO MR. CHARLES THOMPSON, SECRETARY OF THE AMERICAN PHILOSOPHICAL SOCIETY, AT PHILADELPHIA.

*Savannah, May* 5, 1769.

SIR,

I SEND you a small keg of Bene, or Bene Seed, which you will please to present to your Society for their inspection. This seed makes oil equal in quality to Florence, and some say preferable. Some say one hundred weight of seed will produce ninety pounds of oil, others say less, be that as it will, it certainly makes very fine oil, and produces amazingly. If it is put to the trial, care should be taken to have the press well cleaned, so as to leave no tincture from what may have been already pressed; in my opinion, this is an article of consequence, and I believe it will grow in Philadelphia. The way to sow it is in holes about three feet asunder, dropping in each hole about ten grains; when it comes up, thin it to three or four of the most promising, the seeds will appear in pods about September, and should, when full grown, and before dry, be gathered in. The method is as follows. As soon as you perceive about three-fourths or four-fifths of the pods rise on the stalk, and the lower pods begin to lose their seeds, it is then time to take it in; for after that, as much as ripens one day a top, so much falls out of the pod at bottom, you take a sharp hatchet bill, or some such weapon, and with it cut off the stock twelve to eighteen inches below any of the seed, holding the stock with the left hand, and when cut, a second person receives it, keeping it upright, till he has his load, for if you turn it downwards the ripe seed will fall out of the pods, you may immediately carry it into a barn, and set it upright on a close floor till you perceive all the pods fully dry and open. (You may, if you choose, leave it in the field, which must be the case if a large quantity is planted) then thrash it, and run it through a proper sieve, and it is fit for use.

I am quite unacquainted with the method of expressing the oil, but I believe if it is designed for table use, nothing should be done to the seed, as it might give it an ill taste. The lighter and drier the soil is in which it is planted, the better.

I am, dear sir,
Your most humble servant,
JOHN MOREL.

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## ACCOUNT

### OF A NEW METHOD OF BLEACHING COTTON. BY M. CHAPTAL.

#### READ AT THE NATIONAL INSTITUTE.

THE success with which M. Berthollet has applied the oxygenated muriatick acid to the bleaching of vegetable substances, seems to have brought that art very nearly to perfection ; but this method is not equally advantageous throughout all its branches ; besides which its execution requires very experienced workmen, that the articles may not be injured by using lies in an improper manner. We should not, therefore, neglect to make known, and to improve, all the other methods, in order that the manufacturer may choose that which appears to him the most advantageous. For these reasons, I shall now describe a process for bleaching cotton thread, which is equally simple and economical.

Fifteen or sixteen inches above the iron bars of a common fire-place, is to be fixed a copper cauldron, of a round shape ; its depth should be nineteen or twenty inches. The edges of the cauldron, which should be seven or eight inches wide, are to be turned back, so as to rest upon the brick work. The remaining part of the furnace is to be of stone, built up to the height of six or seven feet ; the width within being about five feet six inches. It should be contracted towards the top, so as to leave a round opening, of nineteen or twenty inches diameter. This opening is to be occasionally closed by a heavy stone, or by a copper cover fitted to it. On the edge of the copper cauldron which may be considered as the bottom of this kind of Papin's digester, is to be placed a grating, formed of bars of wood, very near each other, that the cotton laid upon them may not pass through them, and sufficiently strong to bear the weight of between seven and eight hundred pounds of cotton.

The cauldron being finished in the manner above described, the cotton, in hanks, is to be impregnated with a weak solution of barilla, rendered caustick by quick-lime. This operation is to be performed in a wooden or stone trough, in which the cotton should be trod by the feet, covered with wooden shoes. When the cotton is thoroughly and equally penetrated by the alkaline lie, it is to be carried to the cauldron, and placed upon the wooden grating already spoken of. The superfluous liquor runs through the bars of the grating into the cauldron, and there forms a stratum of liquor, which permits the whole to be heated, without fear of burning either the cotton or the metal.

To make the alkaline lie, a quantity of Alicant barilla, equal to one-tenth of the weight of the cotton intended to be operated upon, is to be employed: in a cauldron of the dimensions above described, about eight hundred pounds of cotton may be operated upon at one time. The lie made use of, is generally of one degree of strength. As soon as the cotton is introduced, and properly placed in the cauldron, the opening at top must be closed with its cover; which should fit in such a manner as scarcely to leave any vent for the vapours, that they may, when disengaged by the fire, acquire a great degree of heat, and thereby act powerfully upon the cotton.

Every thing being prepared as is here directed, the fire may be made in the fire-place;* and the lie must be kept gently boiling for twenty or thirty hours. The whole may be then suffered to grow cool; the cover may be taken off; the cotton taken out, and exposed in the field for two or three days, supporting it upon bars during the day, and letting it lie upon the grass during the night. The cotton will be found to have acquired a beautiful whiteness; and if, by chance, any of the hanks should appear still to retain any colour, they may be put again into the cauldron, and be once more

* In the construction of this furnace, I have supposed that it was intended for burning sea or pit coal. If wood is to be burnt in it; the dimensions must be varied accordingly. In the latter case also, the iron bars would be useless, and the bottom of the furnace would be too high above the ground.

exposed to the effect of the lie; or they may be left a few days longer in the field. These shades in the bleached cotton happen from its not having been, in the first operation, completely and equally impregnated with the alkaline lie: or they may arise from the cotton having been heaped together too closely, in some parts, when put into the cauldron.

When, during the operation, there is reason to suppose that the whole of the lie is exhausted by the ebullition, the cover of the cauldron must be taken off, and the cotton, now become dry, must be sprinkled with a fresh quantity of alkaline lie; otherwise it would be in danger of being burnt.

It is easy to judge, by computing the value of the substances, and the time employed in the above operation, how very economical this method is, even if we had not a more simple and sure way of determining it, namely, the low price at which cotton is bleached in all the manufactories in which this process is employed. In the south of France, where it is pretty generally practised, cotton is bleached at the rate of about a shilling for nearly one hundred.

This process was brought to us from the Levant, some time after the introduction of the Adrianople or Turkey red die. It has been long made use of there, though kept secret from us till this time, and is there called *bleaching by means of vapour*.

I do not know that this method has yet been applied to the bleaching of linen or hempen thread; but it certainly would be very well worth to try it upon those substances. It would indeed be necessary to make use of stronger leys, and to continue the boiling for a longer time than with cotton; and I recommend it to manufacturers, to try this process, both with a view of rendering it more general, and of bringing it to greater perfection.

# NEW METHOD

## OF PREPARING RADICAL VINEGAR,

### FROM THE ANNALES DES ARTS ET MANUFACTURES.

WE have lately received some directions for the making of vinegar denominated *radical vinegar ;* as they present some new facts and methods of preparation that deserve to be known, we shall give them as we receive them from our correspondent.

The experiments that taught me, three years ago, the real distinction between the *acetic* and *acetous* nature of acids, ought not, I think, to be lost to the arts. I gave an account, in part, of their results, in a memoir inserted in the number of the *Journal de Physique* for Vendemaire, in the year 8, but new experiments, made in the laboratory of the unfortunate *Moscati*, perfected my former observations, and I now offer to your journal two processes for making, in a more economical and safer manner, the liquid known at the toilette and in apothecaries' shops by the appellation of *radical vinegar*.

It has always been usual to extract it by gradual distillation from chrystals of copper, in earthen vessels, in a reverberatory furnace. This violent heat, giving to the fluid an extraordinary expansion, frequently caused disagreeable accidents ; it even destroyed great part of it, which occasioned the great quantity of carbonick acid, that chymists had always noticed, without being able to explain how it was formed ; the part saved was always intermixed with particles of copper, which were the more difficult to extract from it as that metal has a great affinity with the acetick acid. The new chymistry did not correct this process because it had long considered as essential to the formation of the acid what in fact is only an inconvenience arising from the defect of manipulation.

My first process, which consists simply in pouring one part of concentrated sulphurick acid to one of acetite of copper, and distilling it on a sand-bath, remedies every inconvenience, and prevents all danger attendant on manipulation. This was the process I published in the Journal des Pharmaciens, of which Citizen Fourcroy was then the editor: it appeared of sufficient consequence to be inserted in the Manuel du Chemiste.

It was in Italy that I conceived the idea of the second, during the severe winter of the year 7. I, at that time, made many experiments on the action of cold on vegetable acids; and comparing this action on the acetous acid with that of the sulphurick acid, I observed that both of them acted in the same manner, with respect to this liquid. I discovered, by means of this extraordinary similarity, that the reverberatory furnace produced radical vinegar, and that extreme cold produced it likewise. Many explanations resulted from this piece of discovery, and I shall probably soon be able to bring to light an infinite number of others not to be found either in the Journal de Physique, or any where else.

I confine myself to what is merely practical. I take a kilogramme of white vinegar concentrated by the frost, I pour to it half a kilogramme of concentrated sulphurick acid, and distil the mixture in a sand-bath, till the vapours of the sulphureous acid begin to appear. I obtain a light and strongly scented liquid; but I confess this liquid requires distilling a second time before it is the radical vinegar.

This process, it is obvious, is simple, and the residuum exposed to a sudden heat may serve a second and a third time; and by increasing the quantity of sulphurick acid one half, the vinegar need not be exposed to the frost. It is true, the second distillation will greatly augment the expense. Artists will ascertain whether this expense be as heavy as that incurred by the ordinary process, wherein acetite of copper is used: I think not. It is at least certain, that my acetick acid may be used without those apprehensions caused by that now sold. Let females, who only use it as a luxury, reflect, that when respiring its odour, they introduce into their lungs more or less copper, one of the most powerful poisons, and they will be the first to discountenance the former process, in order to introduce those which I propose.

As the produce from both is not liable to any kind of suspicion, the only point is to calculate which of them, being attended with the least expense, deserves the preference. This calculation I leave to the artists who read your journal, to which I consign them.

# METHOD

## OF PROCURING GOOD WATER FROM WELLS.

### FROM THE DECADE PHILOSOPHIQUE, &c.

IF you wish the water of a well to be clear, and free from any disagreeable taste, the excavation should be made considerably larger than is usually done.

If, for example, you wish to construct a well five feet in diameter, the excavation ought to be from twelve to fifteen feet. A false well is made ten or twelve feet in diameter; in the middle of this large well the real well is constructed with a diameter of about five feet, but in such a manner that the water may filter through the interstices left between the stones, which form the outside of the inner well: the false well is then filled with sand and pebbles, so that the water must first filter through them before it reaches the real well. By this method you are sure of having filtered water perfectly clear and fit to drink.

This operation is rather expensive it is true; but the expense is amply compensated by the advantage of having limpid and wholesome water.

# SUBSTANCE

## OF THE SPECIFICATION OF A PATENT GRANTED TO MR. ARNOLD WILDE, AND MR. JOSEPH RIDGE, OF GREAT BRITAIN FOR MAKING AND MANUFACTURING DIFFERENT KINDS OF SAWS, &c.

THIS invention is described as follows:

" Our said invention of making and manufacturing all kinds of saws, steel doctors for printers, plates made of iron, also of steel, beads, mouldings, and fender plates made of iron and steel united, or of iron or steel, and all sorts of springs made of steel, and divers others articles made of iron and steel united, and also of iron or steel, is particularly described and ascertained in manner following; that is to say: When the steel or iron is pared or cut into proper shape, the saws, doctors for printers, plates of iron or steel, beads, mouldings, and fender plates, whether made of iron and steel united or of iron or steel, and all sorts of springs made of steel, and divers other articles made of iron and steel united, and also of iron or steel, are put into a frame of metal, or otherwise: they may then be made red-hot in the said frame, and stretched by screw, spring, weight, or any other proper power or purchase, and so formed into a curved, straight, or any other direction wanted. They are then to be immersed in water, or a composition of oils or grease, to be hardened in the frame in the direction wanted; and when so hardened they are also to be tempered in the same direction in the frame over fire: and when the saw, doctor for printers, or plate, is over the fire, it must be kept in motion over the fire until the oil or grease upon the said saw, doctor, or plate, smokes. It is then to be gently stretched, and continually kept moving over the fire until a blue blaze alternately appears and disappears. It is then to be stretched with as much power as will bring it into the direction required. The saw, doctor, or plate, is next to be put into another frame, which may be made to move upwards and downwards, or in any other direction necessary, by crank, or any other movement, between proper stones, or between plates of metal, blocks of wood, or any other material that will grind or polish with sand, emery, or other proper material to grind and polish the saws, steel doctors for printers, plates made of iron, also of steel, beads, mouldings, and fender plates, made of iron and steel united, or of iron or steel, and all sorts of springs made of steel, and divers other articles made of iron and steel united, and also of iron or steel. But if the saw, doctor, or plate, is not intended to be hardened, it must be made red hot, and stretched with as much power as will bring it into the direction wanted; it must then lie in the open air, in the frame, in the said direction required, till cold: then to be ground by a machine for the purpose of grinding and polishing in a frame the said saws, steel doctors for printers, plates made of iron, also of steel, beads, mouldings, and fender plates, made of iron and steel united, or of iron or steel, and all sorts of springs made of steel, and divers other articles made of iron and steel united, and also of said saw, doctor, or plate, by means of a crank, or otherwise, as before expressed;

and which motion will pare, tooth, smith, finish, set the teeth of saws, sharpen, grind, and polish, plates made of iron or steel, or of iron and steel united, and form beads and mouldings, and various other articles. In witness whereof, &c.

# METHODS

## OF PREPARING A SPECIES OF WRITING INK, INDELIBLE EVEN BY THE ACTION OF THE OXYGENATED MURIATICK ACID; COMMUNICATED IN A LETTER FROM M. SCHERER TO MR. VAN MONS.

FROM THE ANNALES DE CHEMIE.

AS common writing ink is susceptible of being effaced by oxygenated muriatick acid; and as the knowledge of this fact may be abused to very fraudulent purposes; chymists have judged it an object of importance to try, whether a writing ink might not be prepared, which should entirely resist the action of that acid. Pitet, with this view, added to the ink commonly in use, a portion of indigo. But this addition is of no service if the ink be not carefully shaken every time it is employed. Westrumb recommends the following composition of ink, as absolutely indestructible. Boil one ounce of fernambuca, and three ounces of nut galls, in forty-six ounces of water, till they shall be reduced thirty-two ounces in all. Pour this decoction, while it is yet hot, upon half an ounce of sulphate of iron, or martial vitriol, one quarter of an ounce of gum arabick, and one quarter of an ounce of white sugar. After these substances are dissolved, add to the solution one ounce and a quarter of indigo, finely pulverized, with three quarters of an ounce of lampblack, very pure, or of smoke black, previously diluted in one ounce of the best brandy. M. Bosse gives a receipt, which is still more simple. He directs to boil one ounce of fernambuca with twelve ounces of water, and half an ounce of alum; to continue the ebullition till the liquid mixture shall have been reduced to eight ounces; then to add an ounce of oxyde of manganese, which you have reduced by decantation to extreme fineness, and, in mixture with it, half an ounce of gum arabick.

## MR. JAMES BARRETT'S PATENT

### FOR IMPROVEMENTS IN THE CONSTRUCTION OF MALT KILNS. DATED JANUARY, 1805.

THE improvements in malt-kilns, for which this patent was obtained, consist principally of four separate articles, the first of which relates to means of regulating the fire to any required degree, of admitting heated air to the malt, and of preventing the absorption of heat by the walls of the kiln; which are all judicious applications of the inventions of count Rumford, for the general improvement of fire places, to the particular exigencies of malt kilns, as Mr. Barrett candidly acknowledges.

The second consists of a contrivance for closing the superiour aperture of the kiln to any required degree.

The third is a moveable furnace running on wheels, which may be set in a kiln for drying either pale or brown malt, but is mentioned as principally intended for the former.

The fourth is a contrivance for admitting the use of common pit coal, in drying malt, mentioned by Mr. Barrett as chiefly applicable to the moveable furnace; but which could, no doubt, be equally well used with a fixed furnace.

The fire is regulated in Mr. Barrett's kiln by dampers, which close the passages which admit air to the fire as required, and these are so connected by chains and pullies with the regulator of the opening for admitting fuel (through which the air can pass to the malt without going through the fire) that the closing of one occasions a proportional opening of the other; a plate of iron lies directly over the fire, at a considerable distance above it, and admitting a free passage round it on every side, whose office is to prevent the heat from striking intensely in one spot, and to distribute it more equally under the whole wire, hair-cloth or tiles, for sustaining the malt, which last are recommended to be supported by a frame made of narrow iron bars, crossing so as to form small squares, or to be what Mr. Barrett calls an iron hurdle, which, he says, has particular advantages for drying brown malt.

A number of small apertures, communicating with air tubes which circulate round the neck of the kiln, are made both above and below the drying frame; dampers are fixed in the air tubes in such a manner that the air, heated by passing round the neck of the kiln, can be made either to pass out above or below the malt at pleasure: this contrivance, Mr. Barrett says, effectually carries off the great quantity of steam which is generated in drying the malt; and is particularly serviceable in the process of drying pale malt: the extremities of the above passages are closed with iron lattice to hinder vermin from entering.

To prevent the absorption of heat, the walls of the kiln are built hollow, or with hollow passages in them, at every side; the floor of the ash-pit, and the whole area on which the kiln stands, is laid on arches for the same purpose.

The regulator for closing the upper part of the kiln consists of four sheet iron quadrants, which turning on pivots in the line of the middle radius of each, in such manner that when in a horizontal position they form a completely close disk, which stops the whole of the aperture, and when in a vertical position they leave it entirely open; in all intermediate positions, they leave a passage for the heated air to pass out proportionate to their degree of inclination, and, when so placed, resemble much the fliers of a smoke-jack; a wire passes from each quadrant a little way down and hooks to another wire or chain, common to all four, which passes down to the front of the fire-place, and by pulling which the workmen can close the upper aperture to any degree he chooses; it may be easily conceived how, on letting go the wire, the quadrants could be contrived to open, by having weights so fixed to them, as to make them preponderate at one side of their centres of motion.

This regulator will at once extinguish all accidental fires in the kiln; will economize heat in preventing the access of cold air downwards on the malt when the drying first commences (which will be particularly useful in drying pale malt) and, by being closed when the kiln is not in use, will protect the kiln-wire, or hair cloth, from damage by the weather, or soil from birds.

The moveable furnace is of an oblong shape, and is constructed with a fire-chamber, and ash-pit, with doors and registers in the same manner as a chymical furnace; there is a damper annexed to it, so contrived that, by moving it to a certain degree, a new passage is opened for the fire into the iron flue next to be described, and the direct passage to the malt closed.

The use of this iron flue (which forms the fourth principal contrivance) is to permit the burning of common coal for heating the kiln, when culm or coke cannot easily be had. It consists of a flue of cast-iron, through which the smoke passes into a chimney, around which another tube is made to pass spirally, one extremity of which communicates with the space beneath the frame for sustaining the malt, and the other is connected with pipes passing through the body of the fire (or where they will receive considerable heat from it) to the external air. By this means the air is heated so, in circulating round the iron flue, as to dry the malt effectually, and at the same time be totally separated from the smoke.

Mr. Barrett recommends the use of iron in the formation of the cowl, of the internal doors, and of the window frames, as being not liable to warp or shrink, and free from danger of burning.

Besides these contrivances, Mr. Barrett mentions two doors of iron or earthen ware, moveable at pleasure, placed at each side at the further end of the neck of the kiln, to equalize the flame arising from wood, in drying brown malt, which seems to be particularly useful, as Mr. Barrett says this object cannot be obtained by any skill or labour of the workmen, in kilns of the old construction, but of which he has unfortunately given no accurate description either as to their size, position, or management.

## OBSERVATIONS BY THE EDITORS OF THE RETROSPECT OF DISCOVERIES.

This kiln of Mr. Barrett's seems to be one of the most complete yet constructed, and to possess every requisite for regulating the fire, preventing accidents, directing the draught through the kiln to any required degree, economizing the fuel, and admitting of a greater variety of it, facilitating the management of the kiln, and rendering this business safe and free from distress to the workman. Mr. Barrett mentions the moveable fire place, as if it possessed peculiar advantages, but, as he has not described what these are, we must only rely on his opinion in this particular; as there is no very obvious reason why it should be better than a fixed fire place.

Mr. Barrett has had the candour to acknowledge the assistance received from the inventions and publications of count Rumford, in the construction of his kiln; but this does in no wise diminish his merit in the judicious application of them to the purposes desired; for it oftentimes requires no less ingenuity to direct a former invention to suit a new purpose, than originally to plan it.

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## ON THE DISTILLATION

### OF ARDENT SPIRITS; AND THE PREPARATION OF YEAST. BY BARON VON MESTMACHER.

FROM THE TRANSACTIONS OF THE ECONOMICAL SOCIETY OF PETERSBURGH.

1. THE vessel in which the grain is to be infused should be rather broad than deep; and it ought to be covered with a lid, fitted to it so closely as to prevent the escape of any vapour from within.

2. Before putting in the grain, let this vessel or mash tun be carefully washed with boiling water. Scrub, at the same time, both its bottom and sides, with a stunted besom.

3. Then turn the vessel upside down; place it, with the brim, at one side, about half a foot from the ground; make under it a fire of straw, or rather of dried juniper twigs, and let this blaze up, into the reverted vessel, for about the space of a minute; then scour the vessel twice with hot water, and put it in its place.

4. To procure to the quantity of a hogshead of spirits, by one process, take a copper boiler, sufficient to hold four times this quantity of water, and bring to boil in it as much as shall be requisite for the infusion of your grain.

You must, at the same time, have in readiness a due quantity of grain, ground to considerable fineness. Next pour into the mash tun about a hogshead of boiling water. Add your ground corn. After this has been thoroughly agitated in the mash tun, pour upon it a bucket more of water. Let four men, with shovels, of the form of oars, now stir the grain about in the mash tun, till not a particle of it be left unmoistened. In order to ascertain whether this be so, examine the mixture with your hand, after it shall appear to have been sufficiently agitated with the shovels.

5. Next, pour in another tun of boiling water. You must have reserved a few pounds of your meal, for a subsequent part of the process. Mix the rest, as quickly as possible, with the water, by means of your shovels. Pour more boiling water upon the mixture, till the whole shall be reduced nearly to the consistency of water gruel. Then strew that which you reserved over the surface of the thin mixture in the mash tun, which will have the effect of preventing the unnecessary waste of the spirit by evaporation. All this part of the process must be finished within half an hour at the utmost. If it be more slowly and negligently performed, there will be a considerable waste of spirit from the grain, in the evaporation of the boiling water.

6. It is almost impossible, on account of the varying temperature of the atmosphere, and of the difference in the strength of the grain, as well as for other reasons to proportion the water, at all times, with minute exactness. But it will generally be best to use a large, rather than a scanty proportion of fluid. Great care is, at the same time, requisite, to prevent the mixture from settling on the bottom of the vessel, and being reduced into a burnt state, in which it shall be unfit to afford spirits of the desired purity. If the mixture be too thick, or if the material be buckwheat; such an accident will be very apt to take place. It is better to employ equal parts of buckwheat and oats, than to use the former grain alone.

7. After the mixture has been, in this manner, duly prepared, the mash tun must be closely covered with its lid; and the whole must be left to stand undisturbed for the space of at least seven hours. At the end of that time, the formation of the spirit will be found regularly to commence. If it be then neglected, the spirit will wastefully evaporate, and the remaining liquid will quickly begin to putrefy. This last event will take place so much the sooner, if the mash tun, as may too often happen, have not been properly scoured before the commencement of the process.

8. At the end of seven hours, remove the lid of the mash tun a little to one side, and observe carefully whether a peculiar acidulous vapour, distinguishable by the smell, do not arise from the liquor thus uncovered.

This vapour, however, does not begin to ascend till bubbles cease to appear on the surface of the liquor. Great attention and experience are necessary to enable one to seize the exact moment when the fluid is brought to this state. It is better, however, to anticipate that moment, than to suffer it to pass unnoticed. Two-thirds of the spirit are often lost by neglect of this sort, before the operator is aware that it has begun to be formed.

7. Next, add to the liquor ten pints of yeast. Agitate it with the shovel or ladle, for the space of a minute. Then cover it, as before, with the lid. Yet, leave somewhere a small opening; carefully stopping it with a bit of rag, or any other fit substance, to exclude the external air. In this condition leave the whole standing, for the space of 72 hours; or, if the weather be very cold, even for 84 or 98 hours. After it has stood, however, for 72 hours, you may uncover it, and observe, whether there be not a heaving motion of the whole mass, with a thick yellow scum spread over the surface. The most profit is to be expected, when you can seize the exact moment of the highest fermentation of the whole mixture. It is always better to anticipate this moment, than to delay till after it has passed.

10. We proceed next to the distillation. For this purpose, the fermenting liquid is to be drawn off into a still, or any vessel with a high covered head, and connected by a suitably incurvated pipe, with a receiving vessel which may stand beside it.

11. But, it will be proper, first, to describe the fire-place over which the still is to be fixed. The distillatory copper ought to stand at the height of about one and a half feet from the ground, in such a position, that the fire may not only heat its bottom, but diffuse the flame around it, so as to rise upon its side. A foot below the top of the vessel, there should be, on each side, an opening in the brick work, either round or square, for the convenience of regulating the fire within. In the fire place, or stove, there ought to be kept up a strong fire of dry wood, till such time as the liquor in the still shall be brought to ebullition. While this is going on, a person with a ladle, or shovel, sufficiently sharp at the edges, should carefully raise the matter from the bottom, so that it may not settle there, and become singed or burnt.

It is much more advantageous when there is a copper lid for the still or boiler, having, in the middle, a round orifice, half a foot in diameter, which may receive the handle of the instrument that is used to stir the fluid within. This prevents any loss by evaporation at the time when the necessary agitation of the liquor is performed. When the ebullition has once commenced; the force of the heat elevates both the thicker parts of the mass, and those which are more fluid; and there is no longer danger of their subsiding and being scorched upon the bottom.

12. As soon as the fermented liquor begins to boil, let the capital or head of the distilling vessel be put on. Lute it with dough, or paste, to the vessel which it covers. Fill up the fire place beneath with logs of wood not too dry. Then shut up the inferiour access to the fire, either with the iron doors, or, in want of these, with brick and lime. With a stove once, in this manner filled with wood, you may, without any second supply of fuel distill to the quantity of twenty-eight hogsheads of the wash; for, after the distillation has commenced, it is not a very intense heat that is required; and the fire can always be kept alive by means of the side holes which were before mentioned. To diminish the heat, and stop the progress of the distillation when this is too rapid; nothing more is necessary than to stop up the holes in the sides. On the other hand, when the heat is too languid, it may be excited to sufficient briskness, by opening the side holes more freely to the access of air.

13. The spirit must be now suffered to pass off in a state of as great strength as possible. Great care is requisite to prevent a waste of the spirit by evaporation. To avoid this waste, the liquor of the first distillation, or *low wines*, is not urged to any degree of purity. From three to three and a half hogsheads of this liquor are taken, to afford one hogshead of the *raw spirit.*

14. This raw spirit is next to be put into a smaller copper, such as may hold not more than three and a half or four hogsheads. If the size of this vessel be larger, it will occasion an inconvenient waste of the spirits.

15. The second distillation is to be conducted like the former, in all respects, save that it is not now necessary to agitate the liquor in the still. The head of this still too, should be covered with tin, that it may not be cor-

roded in the progress of the distillation. The phlegm which remains after all the spirit has passed, should be carefully reserved for use in the preparation of the next wash. Thus are obtained, from one hundred weight of rye, about ten gallons of raw spirit: from one hundred weight of malt, about six gallons of the spirit;* and, from the same quantity of buckwheat, seven gallons and three quarters.

Rye is not susceptible of complete distillation by itself. The wash in which it is used should be made with half rye, half malt. A mixture of four hundred weight of rye, three hundred weight malted barley, and one hundred weight of buckwheat, will yield sixty-five gallons of strong spirit.

I have tried to distil spirits from unmalted barley, but cannot say I found it profitable. Oats may be used when there is a want of malt, to forward the distillation of rye or buckwheat.

16. Barley may be malted for distillation, nearly in the common way in which malt is prepared for the brewers. Only, the process should, for the distiller's purpose, be concluded sooner; and the germination should not be suffered to proceed so far as in malt that is to be used in making beer.

17. The distillatory vessel ought to hold not less than 14 hogsheads; and it should be fitted with two worms and two sets of receiving vessels. But, as this apparatus might be often too expensive; a still of seven hogsheads, with a single worm, and only one set of receiving vessels, may be employed in common. You can now divide your wash into two portions. One of these may be made to pass through the still in the space of five hours. The second portion may be then put in; and its distillation will be easily finished within an equal time. The still for the re-distillation of the *low wines*, or liquor of the first distillation, should be of a capacity to hold four hogsheads; and should be put up in the same manner as the other. With these two stills, may be easily made a hogshead of spirits daily, without its being necessary for the distiller to work by night. The whole process of preparing the

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* It has been found, also, by the Scottish distillers, that new grain yields a larger proportion of spirit than malt does.

wash, and conducting it through the different steps of the distillation, may be accomplished in fourteen hours.

18. In order, however, thus to prepare daily a hogshead of spirits, you must have four mash tuns. Each of these must be large enough to hold fourteen hogsheads of water, with a vacancy of half a foot between the upper surface of the water and the lid that covers the vessel; a vacancy necessary to afford room for the heaving of the wort while it is in fermentation. It is needless to be anxiously exact in proportioning the water for the warm mash: for a hogshead more or less will make no difference. But, in the subsequent part of the process, greater exactness as to quantity becomes necessary; and you should then have neither more nor less than fourteen hogsheads.

19. If the quantity of water employed in the preparation of the wash be too considerable, which is to be discerned by any extraordinary slowness in the cooling of that liquor; then, let the cooling be artificially hastened by putting in a small piece of ice, or by any other convenient means. It should be cooled down somewhat lower than a blood-heat, and nearly to that of milk fresh from the cow in the summer months.

20. But, to speak of the distillation of these spirits, rather as a chymical process than a vulgar art; I know no better method of regulating the heat, in these cases than by the thermometer. This thermometer ought accurately to indicate the degrees of heat which experience has proved to be the most suitable for the present purpose. By the insertion of the bulb in the cooling liquor, the mercury will be raised to show its exact heat: and the distiller, after a short experience in the use of this instrument, will become able to distinguish the proper heat by sensation alone. The utmost nicety as to this point is certainly at all times necessary. Any errour on either one side or the other, could not fail to occasion very serious inconvenience and loss.

21. The vessel ought to have a copper lid with a hole in it, to receive the ladle with which you are to stir the liquid. That lid is to remain on the still, while the stirring is requisite; but ought to be removed, when the distillation is to commence, and the alembick or capital to be applied.

22. Of the distillatory vessel it is to be remarked, that the lower and the wider this is made, so much the more profitable will its use be. When the still is wide and shallow, the distillation is necessarily more rapid and more complete. The capital should not be flat, but of a semi-globular form, that the spirit, as it rises, may not fall back into the body of the still, but may be detained on the sides of the capital, and conducted through the worm into the receiver. Round the inner part of the capital there should run an oblique enchasement for the very purpose of conveying the condensing drops into the worm. It is further necessary, that this capital be well tinned and polished: for the spirit acts strongly on copper; and any unevenness of either the tin or the copper, would interrupt the course of the drops, and thus incommode the distillation.

23. Snow or rain water is undoubtedly the best for the use of the distiller: after that, river water. The water of brooks and springs is harder, and therefore less fit for our purpose. When, however, no other can be procured, this may be boiled with a handful of salt previously cast into it, and then employed in the preparation of the wash.

24. There are great diversities in the strength of grain to afford spirits by distillation. If your grain have been damaged in the growth, if it have been heated in the barn or stack, if its germination have been suffered to advance too far in the malting; in any one of these cases, its value will be exceedingly diminished to the distiller. It is a great mistake, therefore, to suppose, that damaged or over malted grain, may be applied with peculiar advantage to this use. There is at all times, and with the best grain, a very great loss of the spirit in the worting, and the distillation.

25. The following is my method of preparing good Yeast. When your wort is made, and it seems nearly time to provide yeast for its fermentation, take out forty gallons of it into a separate vessel. Let this vessel have a lid to cover it, and let it be somewhat larger than is necessary to contain the exact forty gallons. Have in readiness a quantity of leaven: and of this take seven pounds; which dilute with a little of the wort, in any convenient dish; stirring it with a spoon or ladle, till the leaven shall be entirely dissolved. Pour this diluted leaven into your forty gallons of wort,

Add seventeen pounds of rye meal, and an equal quantity of ground malt. Mix the whole, by agitation, for some minutes; then leave it at rest for half an hour. At the end of this space, add a spoonful of the best yeast, and mix it thoroughly with the whole mass. Put the lid upon the vessel, to keep it close from the external air; and let the whole remain undisturbed for forty-eight hours in a moderate temperature. At the end of this time, it will be found to be wholly converted into yeast. The quantity will be sixty gallons of the best yeast from your forty gallons of wort.

## FRENCH MODE OF MAKING SALTPETRE.

TAKEN FROM A TREATISE ON SALTPETRE. BY JAMES MASSEY, ESQ.

MEMOIRS OF THE MANCHESTER PHILOSOPHICAL SOCIETY.

THE saltpetre makers at Paris chiefly make use of the rubbish of old houses, the ruins of old vaults and cellars, &c. this they reduce to a coarse powder, and, having screened it, proceed as follows. They provide a number of small open tubs, which they prefer to large ones, upon account of their being more easily moved and emptied of the materials. These they place upon stillages, about two feet high, and in such a manner, that one vessel may receive the lie that runs from two of them. In each tub, near the bottom, is fixed a spiggot and faucet; and to prevent the wood-ashes from choaking the latter, a parcel of the round earth is thrown in first, and the ashes upon it. They then add the remainder of the earth, in the proportion of two bushels of the latter to one of the former. They throw the earth in lightly, that the water may more readily pass through it, and they hollow it at top, that it may more conveniently receive it. They have different numbers of these tubs, but generally twenty-four, which they place in three rows, eight in each: and into each tub they throw three bushels of wood ashes, and six of earth. Ten *demiquieus** of water, being passed through the first row of eight tubs, are poured upon the second, and afterwards upon the third; and now the first row of eight tubs, being emptied of the earth and ashes, is replenished with fresh materials, and the lie, which has passed through the rows of eight tubs, is passed through this likewise. Having thus passed through four rows of eight tubs, and been reduced to two *demiquieus* by the absorption of the materials, it is carried to the boiler under the name of *le cuite.*

Such is the process when a new work is erected; in an old one, only six *demiquieus* of water are passed through the three rows of eight tubs, which are filled with fresh materials every day. The lixivium is carefully scummed during the boiling, and, when it is so far advanced that a pellicle begins to appear upon the surface, a workman is constantly employed, with a perforated ladle, to take out the marine salt, which now begins to form, and fall to the bottom of the boiler; this, being thrown into a wisket, drains into the boiler again. When the lixivium is so far evaporated that a drop of it will congeal upon a piece of cold iron, it is taken out, and thrown into a tub, for the remainder of the marine salt, and other dregs, to settle; and, after standing about half an hour, it is drawn off, whilst yet warm, into shallow copper pans, and set in a cool place for the saltpetre to crystallize. The produce of this operation is generally about one hundred and thirty pounds of a brown sort of saltpetre, which is sold to government for three pence halfpenny per pound, and carried to the arsenal to be refined.

The liquor remaining in the basins, when the saltpetre is crystallized, is called *eau mere*, or mother water, and is poured upon the earths in small quantities, when disposed in the tubs for lixiviation; though some makers think it best to dilute it with water, and percolate it through a fresh bed of wood ashes. The earths, when discharged from the tubs, are thrown aside under a hovel, and, when dry, are spread about a foot thick, to receive the scummings, *eau mere*, putrid urine, or any other putrid liquor they can get to throw

* A demiquieu, as far as we can learn, contains about ninety gallons.

upon them, and in a few months, we are told, are fit for use a second time ; particularly, if now and then turned over. To improve the colour of this saltpetre, and to cleanse it still more from the marine salt, two thousand weight is thrown into a large boiler, with one *demiquieu* of water, in which it dissolves, and, in the course of the boiling, another *demiquieu* is added by pailfuls, which every time it is thrown in, raises a thick scum that is carefully removed ; and now, the evaporation being pretty far advanced, and the marine salt taken out as before, a large pitcher of whites of eggs, or of a solution of isinglass, or of English glue is poured in, and well stirred up in it, which raises a thick black scum, and is taken off with it ; but, before the whites of eggs, &c. are thrown in, the boiling liquor is cooled, by adding a pailful of cold water. The lixivium being thus clarified, is treated as before.

The *eau mere* of this operation, being boiled again, yields a saltpetre of the same colour with the first ; and some saltpetre goes through a third operation of the same kind, to give it a greater degree of purity. The basins, in which the lie is set for the saltpetre to crystallize, are closely fitted with wooden covers, to prevent the too free entrance of the air, which, by cooling the liquor too soon, would not admit the crystals to form of so large a size. The crystallization is generally completed in two or three days ; and about one-fourth part is supposed to be lost in refining.

# SUBSTANCE

## OF THE SPECIFICATION OF A PATENT GRANTED TO MR. WILLIAM KER, FOR AN IMPROVEMENT IN BREWING ALE, BEER, PORTER, AND OTHER MALT LIQUORS, WHEREBY A GREAT SAVING IS MADE IN THE CONSUMPTION OF HOPS, &C.

THE steam which arises from the boiling copper, or any other vessel employed for the purpose, and which steam is strongly impregnated with the essential oil, in which the flavour of hops consists, instead of being allowed to escape and evaporate, as is done in the present mode of brewing, is preserved and condensed. The oil and water together are returned into the worts when boiled, or the oil, after being separated from the water, along with which it had been exhaled, is returned into the worts after they are boiled ; and the watery part, which, after the oil is separated, still continues impregnated with the aromatick taste and bitter of the hop, is returned into the next copper or boiling-vessel ; and so on, from one copper or boiling vessel into another; By which process a considerable part of the hop and flavour, which is lost in the ordinary mode of brewing is preserved: the flavour of the liquor is improved by the preservation of the finer parts of the aromatick oil ; and the ale and beer are better secured from any tendency to acidity or putrefaction, and therefore must be fitter for home consumption, and exportation. However, neither the principle nor the execution of this invention depend on the particular way or means by which the steam is condensed and the essential oil is preserved, which may be effected either in a still, or in any copper, or boiler of any kind, having a winding-pipe similar or the same as a worm to a still, or a straight pipe laid in cold water, or carried through any cooling body or medium, and, in short, in any of the various ways in which steam evaporated from a boiling vessel may be condensed. In witnes, &c.

# EXPERIMENTS

## UPON THE PURIFICATION OF CRUDE SALTPETRE, BY MEANS OF CHARCOAL POWDER; BY MR JOHN GADOLIN, MEMBER OF THE ROYAL ACADEMY OF STOCKHOLM.

FROM THE TRANSACTIONS OF THE SAID ACADEMY.

1. CRUDE saltpetre contains various heterogeneous substances, of which the principal are, sea salt, *sal digestivum*, magnesia, and calcareous earth, all which are united to the nitrous acid: there is besides a certain quantity of *greasy matter*, which sometimes is accompanied by volatile alkali. The different proportion which these salts bear with respect to the pure saltpetre, when crystallized, and the deliquescent nature of the forementioned earthy neutral salts, furnish obvious means for separating them from each other; but, so long as any considerable quantity of the greasy matter remains, it is impossible to obtain good crystals of saltpetre, or to separate and extract from it the other species of salts.

2. The purification of crude saltpetre consists principally in taking from it this greasy matter. This operation is performed in the large way, to a certain degree, by keeping a concentrated solution of saltpetre boiling, so that the greasy matter may be removed by skimming: but there is apt to remain in the saltpetre a sufficient quantity of this matter to render it foul, which makes it necessary to repeat the operation several times, to bring the salt into such a state of purity as is sufficient for common use.

3. Amongst the means which have been hitherto proposed for depriving saltpetre of this greasy matter, the use of alum is probably the most certain; but, besides its being too expensive to be made use of in the large way, it would occasion the saltpetre to be impregnated with vitriolick acid, if before its lixiviation it did not contain a sufficiently large proportion of calcareous earth. It is therefore to be wished that some process could be discovered, by which saltpetre might be deprived, at a small expense, of its impurities.

4. As charcoal-powder has lately appeared to possess the property of absorbing those impure greasy matters which so often adhere to salts (and even to spirituous

liquors) when it is digested or boiled with these substances,* I thought that a similar process might very probably be made use of to purify saltpetre; with that view I made some experiments, which I now submit to the judgment of the academy.

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* Although it was already known that fresh burnt charcoal possessed a particular disposition to absorb a certain quantity of air, and of some other substances with which it was surrounded, more experience was necessary before we could infer from that knowledge the application which might be made of the power of charcoal, to deprive fluid substances of those viscous, oily, or phlegmatick particles which are mixed with them, and which remain fixed in their pores when once they have introduced themselves.

The improving of spirituous liquors, by throwing a certain quantity of birch charcoal into the still, during their distillation, has been boasted of as an ingenious discovery. We have also been told of the advantage of letting a little soot from the chimney fall into beer while it was boiling; and that the beer became thereby remarkably clear: but these means, though so much extolled by some, have not been acknowledged as true by others; who, on the contrary, have absolutely abandoned them, or at least omitted making use of them, until more knowledge respecting them should be acquired by experiments properly made, and we should be able to determine truly the value of the principle upon which the effect of these means depend.

Mr. Lowitz, of Petersburgh, is probably the first person who published that, by means of charcoal, the acid of tartar, spirituous liquors, and many other substances might be freed from greasy matter, and other similar impurities. (Act. Petropol. Tom. V. Hist. p. 41. ibid Tom. VI. p. 57.) He supposed that there exists in charcoal a strong disposition to attract phlogiston, as it does not lose that principle by burning in a close fire; and from that he infers the possibility of dephlogisticating bodies, even in the moist way. By that he also explains his new method of purifying the forementioned substances. See Crell's Chemische Annalen. 1786, p. 233, 293. Item, 1788, p. 36, 131.

M. Piepenbring repeated Mr. Lowitz's Experiments with success; (Crell's Chem. Ann. 1787, p 157.) so also did Brugnatelli and Westrumb. (Ibid. 1789, p. 50.) But Mr. Fuchs, (ibid. 1788, p. 393.) Mr. Hahnemann, (ibid. 1789, p. 202.) and several others, after having in vain tried to deprive solutions of salts of their brown colour and viscosity by charcoal-powder, combated Mr. Lowitz's theory. Different substances would certainly be differently acted upon, in proportion to the purity of the charcoal; and the cause of their ill success seems very much to have been owing, either to the charcoal not having been properly burnt, or to its having been rendered foul by some foreign vapours, before it was used in the experiments.

I have repeated some of Mr. Lowitz's experiments, and from them I conceived the hope of being able to make use of charcoal-powder to purify saltpetre; a purpose for which it has not, I believe, been hitherto used by any person. But the purity of saltpetre is an object of such importance in making gunpowder, that I took the utmost care in conducting my experiments.

5. I had twelve pounds of crude saltpetre, very brown and watery: at the bottom of the vessel, in which I had put it, there had collected eleven *lods** of a watery brown matter, which I shall call *mother water*, and which I separated from the salt.

A. I threw upon unsized paper eight lods of this crude saltpetre; it was kept in a moderate heat, that it might dry, after which it weighed only 7,15 lods.

B. I dissolved one lod of crude saltpetre in water; and precipitated it by a solution of silver; the *luna cornea*, collected and put to dry, weighed, when dry, 0,0496 of a lod.

C. To five lods of crude saltpetre, dissolved in water, I added a superabundant quantity of fixed vegetable alkali. A small quantity of precipitate, of a dark brown colour, was produced, which was not sensibly increased by being kept in a strong digesting heat; but there was perceived a faint smell of volatile alkali. The weight of the whole precipitate, collected together, was 0,013 of a lod.

D. One lod of the mother-water gave, with a solution of silver, a precipitate, which, after being put upon a filter, and dried, weighed 0,368 of a lod. The lie which passed through the filter, being suffered to evaporate, produced prismatick crystals, some of which were deliquescent in the air, the others were pure saltpetre.

E. From two lods of mother-water I obtained, by means of vegetable alkali, a precipitate of a light colour, which, after having been drained and dried, had the appearance of tripoli, and weighed 0,092 of a lod. This powder was dissolved by marine acid, with a violent effervescence, into a liquor of a clear, but dark, appearance; a greasy scum remained undissolved. The solution, when separated from this greasy matter by the filter, was clear, but became turbid by the addition of vitriolick acid; nevertheless, it became clear again after I had mixed a large quantity of water with it. I also poured some vitriolick acid alone upon the precipitate; a strong effervescence arose, and a powder, apparently of a gypseous nature, remained undissolved.

* A lod is 1-32 of a Swedish pound; it is rather less than half an ounce English, i. e. it is 1-34th of a pound avoirdupois, or nearly so.

The solution, being filtered, produced, by evaporation, long selenitick crystals, and crystals of Epsom salt.

F. Two lods of mother-water, being evaporated to dryness by a digesting heat, became a mass of a dark brown colour, full of irregular cubical crystals; it weighed 0,625 of a lod. Being suffered to remain in a cold room, it attracted a certain quantity of moisture. After being dissolved in water and filtered, there remained upon the filter a quantity of sediment hardly perceptible. I threw into the above mentioned solution, a solution of mercury in nitrous acid, and I was struck with an acetous smell which disengaged itself. The solution lost its dark colour, and became clear; it also let fall a considerable quantity of a white sediment, the greatest part of which dissolved again when it was thrown upon the filter. What remained of it was of a brownish yellow, which, by the blow-pipe, gave a smoke similar to that of corrosive sublimate; after that it changed into a black coal, which was quickly consumed by the help of the blow-pipe, leaving only a small quantity of ashes.

G. Six lods of mother-water, mixed with eight lods of water, and one lod and a half of charcoal-powder, were put over a moderate fire, where they were kept boiling for the space of ten minutes, after which I poured the liquor into a filter, through which I made it pass with twelve lods of boiling water. The filtered liquor was transparent, and of a light yellow colour. I mixed it again with one lod and a half of charcoal-powder; boiled it as before, and filtered it. It passed much more readily through the filter than the first time; and was almost as colourless as plain water, having only a very light yellowish tinge. I again boiled this lie, the volume of which was equal to fourteen ounces of water, upon a moderate fire, and reduced it to the volume of one ounce; after which I set it in a cold place. In a few minutes it was full of white cubical crystals of *sal digestivum*, amongst which there formed, after a longer cooling, a quantity of prismatick crystals of saltpetre: the two quantities together weighed 0,9 of a lod. The remaining lie gave me, by a further evaporation, 0,17 of a lod of cubical crystals. These crystalized salts emitted a smell of muriatick acid, upon being held over the fire; and, when I dissolved them again in water, they left a small quantity of powder undissolved. I threw some vegetable alkali into the solution; it occasioned a precipitate which weighed 0,119 of a lod, and which consisted of calcareous earth and magnesia.

The charcoal-powder which was made use of had gained in weight about half a lod.

6. From the experiments of the preceding section, which I made in order to discover the constituent parts of my crude saltpetre, it follows, that 100 parts of that saltpetre contain about 9 1-2 parts of mother-water; (A) also, that they contain about three sevenths more of muriatick acid than is contained in a corresponding quantity of mother-water; for, according to experiment B, 100 parts of crude saltpetre contained as much muriatick acid as is found in 4,96 parts of *luna cornea;* but, according to experiment D, the muriatick acid in nine parts and a half of mother-water corresponds only to 3,5 parts of *luna cornea.* This proportion, however, may require some correction; particularly when it is considered that the greasy matter, which is absorbed in the precipitation of the metallick calx augments the weight of the precipitate; this is evident from the experiment with a solution of mercury, (F) but, with respect to the foulness, which could not be great, in proportion to the whole precipitation of silver, I think it the less necessary to consider it here, as I observed, on the contrary, that my *luna cornea* appeared more soluble in water (and consequently was more diminished in quantity during the draining and filtering) than a pure *luna cornea* generally is. This probably was occasioned by the volatile alkali which was contained in the mother water; which is capable of dissolving silver, when that metal is united to marine acid.

7. From experiment G, I draw the following inference, namely, that 100 parts of the mother-water contained about 8,5 parts of greasy matter, which was absorbed by the charcoal; now, as the whole of the substances contained in the mother-water, after the dissolution, amounted to 31 parts in 100, according to experiment F, it follows also, that the salts contained in the mother-water (which were principally formed of marine acid united to vegetable alkali, calcareous earth, and magnesia) amounted to 22,5 parts in 100.

Therefore the constituent parts of the crude saltpetre I examined may be considered as, very nearly, eighty-nine parts and a half of pure saltpetre, three parts of neutral salts of the nature of sea salt, one part of greasy matter, and six parts and a half of water, besides the water of crystallization.

8. As experiment G proves that the mother-water may be deprived of the greasy matter, by means of charcoal-powder, I had no doubt that the same thing would happen to crude saltpetre, if treated in the same manner. But what proportion of charcoal would be necessary for a given quantity of saltpetre, and what remarkable phenomena might result from such an operation, were circumstances I wished to inform myself of.

The following is the manner in which I proceeded in making the four experiments hereafter described.

I first threw a pound of crude saltpetre, with the charcoal-powder, and six pounds of pure water, into a copper vessel. I kept the whole boiling upon the fire for the space of ten minutes, and then filtered the decoction through a double filtering paper. I afterwards passed through the filter, two pounds of boiling water, and then evaporated, by boiling, the whole of what had passed through the filter, till a drop of it, thrown upon a cold piece of glass, immediately showed signs of crystallization, and was in a few seconds converted into crystals.

I then poured the whole of the lie into a glass vessel, which I placed, uncovered, in a cold place, that the salt might crystallize. In this way I obtained from the first crystallization, about twenty lods of salt. The remaining lie was then again evaporated, till the same disposition to crystallization appeared as before: I obtained from it about six lods and a half of saltpetre. After a third evaporation, I obtained two lods more. What then remained of the lie produced a small quantity of saltpetre, mixed with a great deal of *sal digestivum*.

## FIRST EXPERIMENT.

After having boiled one pound of crude saltpetre with eight lods of charcoal-powder, in the manner already mentioned, the lie appeared quite as clear as water, and the crystals I obtained from the first and second evaporation were perfectly white and clear. Half a lod of each crystallization, being dissolved in three lods and a half of water, acquired a milky appearance from a solution of silver in nitrous acid; and each of the solutions gave me a quantity of precipitate, weighing 0,002 parts of a lod.

After the evaporation, the crystals I obtained were still very clear, and evidently whiter than good common saltpetre. Half a lod of them, by means of a solution of silver, gave a precipitate which weighed 0,007 parts of a lod.

The crystals of mixed salts which I obtained from the fourth evaporation were still very white, but less clear than the preceding.

The last remaining part of the mother-water was become a little yellowish ; but, I procured from it, by means of vegetable alkali, a white precipitate, weighing about one tenth of a lod, which consisted of magnesia and calcareous earth.

## SECOND EXPERIMENT.

From one pound of crude saltpetre, boiled with four lods of charcoal-powder, I procured a clear lie with a yellowish tinge. The crystals formed after a first, second, and third evaporation, could not, by any means, be distinguished from those which I obtained in the first experiment. They were also affected nearly in the same manner by a solution of silver; for, half a lod of the first crystallization gave me 0,002 parts of *luna cornea*, so did also half a lod of the second. Half a lod of the third crystallization gave me 0,008 parts of a lod of *luna cornea.* What I obtained from the fourth crystallization had a yellowish tinge ; and the mother water then remaining was of a reddish yellow colour.

## THIRD EXPERIMENT.

One pound of crude saltpetre, with two lods of charcoal powder, produced a yellowish lie, from which I obtained, by the first crystallization, very white and clear crystals ; nevertheless, when I examined them more clearly, and compared them with the crystals obtained from the first crystallization in the preceding experiments, I observed that they appeared to have a yellowish tinge. From half a lod of these crystals, by means of a solution of silver, I obtained 0,0006 parts of a lod of *luna cornea.* The crystals produced by a second crystallization were similar, in appearanee, to those of the first ; and half a lod of them gave me, with a solution of silver, 0,0006 parts of a lod of *luna cornea.* The crystals I obtained from a third crystallization were evidently more yellow, like those of saltpetre purified by the usual processes. Half a lod of these crystals gave me, with a solution of silver, 0,012 parts of a lod of *luna cornea*. From the fourth crystallization I obtained crystals of a bright yellow; the remaining lie had a dark brown yellow colour.

### FOURTH EXPERIMENT.

One pound of crude saltpetre, with one lod of charcoal-powder, produced a lie of a dark reddish yellow colour; from which I procured, at the first crystallization, crystals of saltpetre which were sufficiently white, but less clear than those of the foregoing experiments. Half a lod of these crystals, dissolved in three lods and a half of water, produced a lie which, upon my pouring into it some of the solution of silver, became milky, but no precipitate was formed; being filtered, the lie again became clear, but the matter which remained behind upon the filter was not sensible in my scales, and could not exceed the 0,0001 part of a lod. The crystals which I obtained from a second crystallization were similar to those which the preceding experiment gave me at the third. From half a lod of them, by means of a solution of silver, I procured 0,0054 parts of a lod of *luna cornea*. The crystals I got from a third crystallization were yellowish; half a lod of them gave me, with a solution of silver, 0,0135 parts of a lod of precipitate. The lie which remained was of a dark brown colour.

### FIFTH EXPERIMENT.

In order to establish a comparison with the preceding experiments, I dissolved one pound of crude saltpetre in six pounds of water, and I kept it boiling as before, but without adding any charcoal-powder. The filtered lie was of a dark brown colour. The saltpetre which I obtained at the first crystallization was rather of a yellowish colour, and resembled the crystals of the third crystallization in the third experiment. Half a lod of it gave me, by means of a solution of silver, 0,001 part of a lod of *luna cornea*. That which I obtained from a second crystallization was more yellow; half a lod of it gave me, by means of a solution of silver, 0,0045 parts of a lod of *luna cornea*. From a third crystallization I obtained crystals of a still deeper yellow, half a lod of which gave me, with a solution of silver, 0,017 parts of a lod of precipitate of silver. The remaining lie was of a blackish brown colour.

9. It is remarkable that the saltpetre which was obtained (at the first crystallization) from the lies which were completely deprived of the greasy matter showed, by means of a solution of silver, a greater proportion of marine acid than that which still contained a certain quantity of that matter. This is perhaps owing (unless the greasy matter renders the precipitate of silver more soluble in water) to the saltpetre being more disposed to crystallize when the lie is pure; a circumstance which prevents it from separating so completely from the particles of sea salt, or other salts of that nature; as, on the other hand, these particles insinuate themselves in greater proportion, when the lie is much charged with greasy matter, which, by its viscosity, much obstructs a regular crystallization.

By these inconveniences, arising from a laboured mode of purification, need not perhaps be feared in operations on a large scale; where the cooling takes place more slowly, and the crystallization is always more regular. For, that greater proportion of sea-salt which is found in saltpetre produced from a more pure lie, and which is observed only when a small quantity of that salt is found in the lie, does not exceed one-sixth *per cent.* of the weight of the saltpetre. It is probable that a quantity of sea salt so very inconsiderable must be of less injury, in the process of making gunpowder, than the smallest foulness produced by the greasy matter.

On the contrary, there is an undoubted advantage in separating completely the greasy matter, even with respect to the proportion of sea salt, when that salt is found in great quantity in the lie.

For, when the lie was found to contain, in the second crystallization, about ten to twelve *per cent.* (with respect to the saltpetre) of sea salt, or salts similar to it, it was only in those cases in which the greasy matter was entirely taken away, that the crystals which were formed contained a quantity of marine acid corresponding to one-fifth *per cent.* of sea salt. But, when a smaller quantity of charcoal, or none at all, was made use of, the proportion of sea salt amounted to one-fourth and three-eighths *per cent.* And when, at the third crystallization, the lie was found to contain nearly 30 *per cent.* of sea salt, the saltpetre, well purified by the charcoal, contained no more than two-thirds *per cent.* of sea salt; whereas that which had been made without charcoal contained more than double that quantity, or one and a half *per cent.*

9. I concluded, from the foregoing experiments, that two lods and a half of charcoal-powder were sufficient to separate from the lie so much greasy matter, that the crystals should be completely purified at the first crystallization.

Upon that principle I undertook another series of experiments, with the remaining part of my crude saltpetre; proceeding in the following manner.

I boiled one pound of crude saltpetre, with two lods and a half of charcoal-powder, and six pounds of water, for the space of ten minutes, and filtered the lie. I then passed two pounds of boiling water over the charcoal, and evaporated the whole of what had passed through the filter, till it showed the disposition to crystallization before described; I then let it crystallize.

The clear lie which remained was poured off from the crystals, and mixed with twenty-four lods of crude saltpetre, and two lods and a half of charcoal-powder; it was then boiled as before.

I repeated this experiment several times, as is shown in the following table, and, at every crystallization, very white and clear crystals of saltpetre were obtained.

In the first column of the table is set down the weight of crude saltpetre which I used in each boiling. In the second, the weight of the charcoal added to it. In the third, the weight of the crystals of saltpetre obtained. In the fourth, the weight of the precipitate produced, by means of a solution of silver, from half a lod of crystallized saltpetre. In the fifth, the precipitate of silver obtained from the crystals, computed *per cent.* with respect to the saltpetre. In the sixth, the precipitate of silver obtained from the crude saltpetre in the lie, computed, as near as could be (according to experiment B, sect. 5.) *per cent.* with respect to pure and dissolved saltpetre.

| Experiment. | Weight of the crude saltpetre. | Weight of the charcoal. | Weight of the crystallized saltpetre. | Precipitate of silver from half a lod of saltpetre. | Precipitate of silver from 100 parts of saltpetre. | Precipitate of silver, from the ie to 100 parts of dissolved saltpetre. |
|---|---|---|---|---|---|---|
| | Lods. | Lods. | Lods. | Lods. | Parts. | Parts. |
| 1 | 32 | 2,5 | 19,5 | 0,0009 | 0,18 | 5,5 |
| 2 | 24 | 2,5 | 21, | 0,0011 | 0,22 | 9 |
| 3 | 24 | 2,5 | 20,9 | 0,0013 | 0,26 | 13 |
| 4 | 24 | 2,5 | 20,4 | 0,0017 | 0,34 | 16 |
| 5 | 24 | 2,5 | 22,5 | 0,0025 | 0,50 | 20 |
| 6 | 24 | 2,5 | 20, | 0,0018 | 0,36 | 24 |
| 7 | 24 | 2,5 | 21,5 | 0,0020 | 0,40 | 27 |
| 8 | 0 | 1, | 6,7 | 0,0070 | 1,4 | 90 |
| 9 | 0 | 0, | 2,3 | 0, 179 | 35,8 | 300 |

Before the saltpetre of No. 9, crystallized, there was formed on the lie a thick crust of salt; I therefore let it cool, and there soon appeared a quantity of cubical crystals. The remaining lie gave me also (as is seen in the table) two lods and a half of saltpetre, mixed with sea salt.

I dissolved the forementioned crust, and the cubical crystals, in water; there was left a certain quantity of white powder which would not dissolve, and which appeared to be of a gypseous nature: it weighed 0,06 of a lod. From this solution and the last remaining mother-water I obtained, by means of vegetable alkali, a light coloured precipitate which weighed three quarters of a lod; and which, besides a little greasy matter, consisted of calcareous earth and magnesia.

11. From the experiments described in the preceding section, it evidently appears how little sea salt, or other salts which contain marine acid, are disposed to crystallize with saltpetre, even when the lie has been deprived of greasy matter, and crystallization conducted with attention.

But I shall not make any further observations on these experiments, my design having been merely to show, that charcoal is an excellent medium for depriving crude saltpetre of its greasy matter; and that, by its assistance, we may not only obtain saltpetre perfectly pure at the first crystallization, but may also advantageously employ the lie which is poured off from the crystals, as an addition to the following crystallizations.

Besides, as the mother-water, according to experiment G, (sect. 5.) may also be rendered fit for crystallization by means of charcoal-powder, there can be no reason why saltpetre makers may not, with good effect, add this powder to their crude lie, when they boil it.

12. But all operations in the large way require different combinations, and a different manner of proceeding, from those experiments which are made with small quantities. On that account, I cannot pretend to determine exactly how much charcoal may be necessary to purify any given large quantity of saltpetre; in all probability much less than two lods and a half to a pound of saltpetre would be sufficient to produce all the advantage that can be desired. We must therefore have recourse to further experience, to learn the necessary practical facts, and determine the manner of operating

in a sure manner. As, in operations in the large way, the greasy matter appears in form of a scum, we might take away the charcoal at the same time with the scum, and thus separate them, both together, from the lie. In this way, filtration would not be necessary; and the expense of this mode of purification would be very inconsiderable; but, if filtration should be found necessary for operations in the large way, I still think that the expense would be amply compensated by the shortening of the tedious processes hitherto employed, and by the advantage of obtaining a more pure saltpetre than is usually to be had, and which would certainly make gunpowder of a superiour quality to that now made use of.

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## ON THE UTILITY OF IRON RAILWAYS.

BY JOSEPH WILKES, ESQ. OF MEASHAM.

FROM THE SECOND VOLUME OF COMMUNICATIONS TO THE BOARD OF AGRICULTURE.

ON the fourteenth of August, 1799, a party deputed from the committee for conducting the concerns of the Grand Junction Canal, with other gentlemen, attended at my colliery at Measham, in Derbyshire, for the purpose of obtaining occular and satisfactory proof of the utility of the iron railways, previous to that company adopting them (which they have now done) in lieu of some portion of their line of canal. The result of the experiments was nearly thus: one horse, of the value of 20*l.* on a declivity of an iron road five sixteenths of an inch at a yard, drew twenty-one carriages or wagons, laden with coals and timber, amounting, in the whole, to thirty-five tons, overcoming the *vis inertia*, repeatedly, with great ease. The same horse, up this acclivity, drew five tons with ease; he also drew up the road, where the acclivity was 1 3-4 of an inch at a yard, three tons. But on this declivity it is necessary to slipper or lock the wheels, the horse not being able to resist the increased momentum of more than three or four tons.

The same gentlemen proceeded the next day to another colliery I have at Brinsley, in Nottinghamshire, where one horse, value 30*l.* drew, on a road of the same construction, where the declivity was one third of an inch at a yard, twenty-one wagons, of five hundred weight each, which, with their loading of coals, amounted to forty-three tons, eight hundred weight; the same horse drew seven tons up the road. It must be observed, that in both the foregoing statements, the hundred weight is 120 lb. On this road the rails are three feet long each, 33 lb. weight, and calculated to carry two tons on each wagon, laid four feet two inches wide, on stone or wood sleepers, placed on a bed of sleck, so as to fix it solid and firm. The expense of completing one mile of such a road, where materials of all descriptions lie convenient, and where the land lies tolerably favourable for the descent, will be about 900*l.* or 1000*l.* per mile, single road, fenced, &c. exclusive of bridges, culverts, or any extra expense in deep cutting or high embankments. Rails are made from twenty to forty pound per yard, agreeable to the weight they have to bear.

By the introduction of iron railways, constructed on the best plan, canals may extend their useful influence in enriching and improving the country to the distance of ten or twenty miles on either side of them, into high mountainous countries, where canals are almost impracticable: instance the railway of the Peak Forest, in Derbyshire, which joins the Ashton canal, the road from Denbigh to near the town of Derby, and a great many others. In numberless cases, near large towns, they would, no doubt, be of the greatest utility; as for Paddington and the Thames, to different parts of the metropolis, to convey merchandise to and from, as well as speedily and easily take off nuisances from the town, cause less wear to the streets, and prevent many disagreeable consequences arising from the great number of heavy burthened carriages crowding together.

In a great many instances it will occur, where a railway, either connected with a canal or not, will be the mode of a cheaper conveyance than water would be. It clearly appears, in the case of the Ashby canal, that their railway, which is now executing, and a double one, will cost two-thirds less than a canal would have done in the district of their railway, where the ground for a canal is unfavourable, and furnish the article of lime, which it is principally intended to convey, at two-fifths less than a canal would have done, though it is an ascent for some miles on the road ; so it is with the Peak Forest, Derby, &c. In short, wherever the quantity of goods to be conveyed on a railway, having a descent of not more than half an inch in a yard, amounts to two-thirds of the weight, as downgate loading, it is a doubt if it will not, in that case, be a cheaper conveyance than a canal: if despatch is necessary, a railway is more certain than a canal, being far more easily repaired; neither does frost or dry seasons affect the trade thereon.

Iron railways have been used for some years in Shropshire, and other places; but for want of proper system in the forming and laying of such roads, they have been found of little or no more service than wood railways, which, from the late improvements in iron roads, are now in disrepute.

The leading principles of iron roads are, that the ground should be formed true, making a perfect inclined plane, made dry by cutting back-drains, soughing, &c. Sleepers of stone, rather than wood, on which the rails rest, and which should be firmly fixed on a bed of stone, beat small, the horse-path filled with good small hard materials, rails three feet long each, weighing thirty-three pound, to carry two tons, and laid not less than four feet wide.

Iron roads, constructed on this plan, which, I apprehend, is yet far short of the perfection they will arrive at, for the carriage of heavy goods to and from large commercial towns, in conjunction with canals, will evidently be of great national advantage ; and if the turnpike roads through the kingdom were made on the concave system (agreeable to that which I had the honour to transmit to the Board some time since) the first principle of which is to have a perfect inclined plane, a considerable revenue might be derived by government therefrom, without a tax upon the publick. Repairs would be very trifling. owing to water becoming the principal repairing agent ; the traveller would be expedited from the smoothness of the road, and more secure from accident; the commerce of the kingdom speedily conveyed from one point to another, and the farmer would be benefited by the advantage of a rich wash, which might be easily conducted from the roads, over his fields, perhaps in many cases equivalent to the maintenance of the road.

# DESCRIPTION

## OF A METHOD OF SWEEPING NARROW CHIMNEYS, WITHOUT THE INHUMAN PRACTICE OF EMPLOYING CHILDREN.

REPERTORY OF ARTS.

ON the cover of Number XV. of the Repertory several questions were proposed, and among others, how to sweep narrow chimneys, without the inhuman practice of employing children. This practice is the more inexcusable, as in many large cities (Edinburgh, Glasgow, &c.) a mode has been in use, time immemorial, which effectually answers the end intended: it is extremely simple, and any person may execute it from the following short directions.

Procure a rope for the purpose, twice the length of the height of the chimney; to the middle of it tie a bush (broom, furze, or any other) of sufficient size to fill the chimney; put one end of the rope down the chimney (if there be any windings in it, tie a bullet or round stone to the end of the rope) and introduce the wood end of the bush after the rope has descended into the chamber; there let a person pull it down. The bush, by the elasticity of its twigs, brushes the sides of the chimney as it descends, and carries the soot with it. If necessary, the person at top, who has hold of the other end of the rope, draws the bush up again; but, in this case, the person below must turn the bush, to send the wood end foremost, before he call to the person at top to pull it up.

Many people who are silent to the calls of humanity are yet attentive to the voice of interest; chimneys cleaned in this way never need a tenth part of the repairs required where they are swept by children; who being obliged to work themselves up by pressing with their feet and knees on one side, and their back on the other, often force out the bricks which divide the chimneys. This is one of the causes why, in many houses in London, a fire in one apartment always fills the adjoining ones with smoke, and sometimes even the neighbouring house. Nay, some houses have even been burnt by this means; for, a foul chimney, taking fire, has been frequently known to communicate, by these apertures, to empty apartments, or to apartments filled with lumber, where, of course, it was not thought necessary to make any examination, after extinguishing the fire in the chimney where it began.

Some time ago an act of parliament was passed, enacting, that all children employed in sweeping chimneys should have brass plates on the front of their caps, with their masters' names engraved upon them, that, when any of the boys were ill used, their masters might be known and punished. An act to prevent altogether the inhuman practice would be productive of much more solid advantages. It would be no injury to those who at present live by that employment; for chimney sweepers would then be as necessary for the convenience of the publick as now; and those who are now employed are the very people who would then provide themselves with ropes and bushes, or with brushes made for the purpose.

## ACCOUNT

### OF THE METHOD OF MAKING ICE AT BENARES. BY JOHN LLOYD WILLIAMS, ESQ.

FROM THE PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON.

AS the method of making ice in this country, where the thermometer, during part of the year, stands at from 95 to 100 degrees in the shade, has something peculiar in it, I trust the following description of the process will not be unacceptable.

Ice is made in India during the months of December, January, and part of February: but I believe it has generally been considered as necessary to the congelation of the water, that it should have been boiled. However, I can now state it as a fact, with my own observation, for these nine years past, that a large quantity of ice has been made at this place every year, without any preparation whatever; and I have often seen ice of an inch and a quarter thick, notwithstanding I do not conceive that the atmosphere, at that time was sufficiently cold to produce the effect; for I have frequently placed a thermometer, with the naked bulb on the straw, amidst the freezing vessels during the night, and, on inspecting it between five and six o'clock in the morning (at which time the ice makers informed me the cold was most intense) I never found it below 35 degrees. I have even seen ice, of a considerable thickness, formed when the thermometer was not lower than 40 degrees.

The method of making ice at Seerore, near Benares, is as fellows:

A space of ground of about four acres, nearly level, is divided into square plats, from four to six feet wide. The borders are raised, by earth taken from the surface of the plats, to about four inches; the cavities are filled up with dry straw, or sugar cane haum, laid smooth, on which are placed as many broad shallow pans, of unglazed earth, as the spaces will hold. These pans are so extremely porous, that their outsides become moist the instant water is put into them: they are smeared with butter on the inside, to prevent the ice from adhering to them; and this it is necessary to repeat every three or four days; it would otherwise be impossible to remove the ice, without either breaking the vessel, or spending more time in effecting it than could be afforded, where so much is to be done in so short a time. In the afternoon, these pans are all filled with water, by persons who walk along the borders or ridges. About five in the morning they begin to remove the ice from the pans: which is done by striking an iron hook into the centre of it, and by that means breaking it into several pieces. If the pans have been many days without smearing, and it happens that the whole of the water is frozen, it is almost impossible to extract the ice without breaking the pan. The number of pans exposed at one time is computed at about 100,000; and there are employed, in filling them with water in the evenings, and taking out the ice in the mornings, about 300 men, women, and children: the water is taken from a well, contiguous to the spot. New vessels, being most porous, answer best.

It is necessary that the straw be dry; when it becomes wet, as it frequently does by accident, it is removed, and replaced. I have observed water which had been boiled, freeze in a China plate; yet, having frequently placed a China plate, with well-water, among the unglazed pans, on the straw beds, I found that when the latter had a considerable thickness of ice on them, the China plate had none. I have also wetted the straw of some of the plats, and always found it prevented the formation of ice. The air is generally very still when much ice is formed; a gentle air usually prevails from the south-westward about day-light. I had a thermometer among the ice pans, during the season of making ice, with its bulb placed on the straw, and another hung on a pole, five feet and a half above the ground; and commonly observed, that when ice was formed, and the thermometer on the straw was from 37 to 42 degrees, that on the pole would stand about four degrees higher; but, if there was any wind, so as to prevent freezing, both the thermometers would agree.

April 30, 1792, the thermometer in the shade being at 95 degrees, some water was taken up from a well, sixty feet deep, and the thermometer being immerged in it, its temperature was found to be 74 degrees. This water was then poured into four pots or pans, similar to those already mentioned as being employed in the process for making ice. They were also similar to each other in size and construction, except that two of them were new and unglazed, and the two others old, with their pores closed, so that no moisture could transpire through them. These pots were then exposed to a hot westerly wind, in the shade, for the space of three hours, viz. from two o'clock in the afternoon till five. Upon examining them at that time, the water in the old pots was found to be at 84 degrees, and that in the new or porous ones, at 68. After remaining in that situation one hour longer, the water in the old pots rose to 88 degrees, whilst that in the new ones continued at 68.

May 1, at two o'clock in the afternoon, the thermometer then being, in the sun, at 110 degrees, and in the shade at 100, the experiment was repeated, with the same pots as before. After being filled with well-water, they were exposed for four hours, viz. from two o'clock till six, to a hot wind; the water in the old pots was then found to be at 97 degrees, that in the new ones at 68.

The foregoing observations, on the frigorifick effect of evaporation from porous vessels, will perhaps account in some measure, for ice being formed when the thermometer, in the air, is above the freezing point. And the power of evaporation in generating cold may be further elucidated, by the following observations on the effects produced, by its means, in our houses.

| | | |
|---|---|---|
| May 16, 1792, at two in the afternoon, | | |
| The thermometer in the sun, with a hot westerly wind, rose to - - - - | 118 | degrees |
| The thermometer in the shade, but exposed to the hot wind, - - - - - - | 110 | do. |
| Ditto, in the house, which was kept cool by *tatties*.* - - - - - - - - - | 87 | do. |
| June 7. | | |
| Thermometer, in the sun, - - - - - | 113 | do. |
| Ditto, in the shade, and hot wind, - | 104 | do. |
| Ditto, in the house, cooled by tatties, | 83 | do. |

* Tatties are a kind of mat, made of fresh green bushes, or long roots, like snake root. They are affixed to the door, or window frames, and kept constantly sprinkled with water. The degree of cold produced by their means is supposed to be in proportion to the heat of the wind which passes through them, as on that depends the quantity of evaporation.

# SKETCH

OF SOME OF THE PRINCIPAL AMERICAN MANUFACTURES AND MANUFACTORIES; BRIDGES, CANALS, TURNPIKE ROADS, AGRICULTURAL IMPROVEMENTS, PATENT INVENTIONS, &c. COLLECTED FROM VARIOUS SOURCES.*

BY THE EDITOR.

## VERMONT.

IRON mines abound on the west side of the mountains. The first iron mine in this state was opened in Tinmouth, in the year 1785; since which others have been discovered, and worked in Shaftsbury, Rutland, Shoreham, Markton, and Milton. Several have been found, which have not yet been worked. A lead mine has lately been discovered in Sunderland. The vein is in a rock of white flint. The ore is very rich, but the mine has not been opened sufficiently to discover the quantity. In Shrewsbury, in the county of Rutland, is found a mine of that species of iron ore called pyrites; the same in quality, though not in appearance, with what are called brass lumps, from which copperas, or green vitriol is extracted. It is highly sulphureous, and will blaze like a brimstone match when thrown into the fire. From this ore small quantities of copperas have been made, merely for experiment

"There is in the town of Rutland a vein of very fine pipe-clay, which has been wrought into crucibles, that prove very durable. This may hereafter furnish a material for a valuable manufacture of white earthen ware. Numerous quarries of marble, white, grey, and variegated, are found in almost every town from Bennington to the Missiscoui. A quarry has lately been opened in Bennington, which in fineness, and the beauty and variety of its clouds, may vie with the best imported marble. Large quantities of lime are manufac-

* The greater part of this article will consist of extracts and abridgments from the works of various writers, as the Editor has not yet had an opportunity to examine in person the subjects which are here treated of nor to complete his contemplated arrangements for procuring information from gentlemen, from whose correspondence he hopes to obtain further and more minute accounts.

tured in Caledonia county, from a species of marle, dug out of marshy ground, first made into brick, then burned to lime. Though not so strong as stone lime, it yet answers a valuable purpose to the inhabitants.

"There are several distilleries for corn spirits in this state. At Middlebury is a porter brewery on a pretty large scale. The iron manufacture is carried on to a considerable extent. In the county of Bennington are three forges and a furnace. In the counties of Addison and Chittenden are five forges. In common seasons, large quantities of maple sugar are manufactured for home consumption. It has been estimated by a competent judge, that the average quantity, made for every family back of Connecticut river is 200 pounds a year. One man, with but ordinary advantages, in one month, made 550 pounds, of a quality equal to imported brown sugar. In two towns in Orange county, containing not more than forty families, 13,000 pounds of sugar were made in the year 1791. In some parts of the state the inhabitants are beginning to line the roads with maple trees. And it would certainly be a wise measure if this practice should become general throughout the states. Orchards of these trees, planted on sloping hills, so as to render it easy to collect the juice, might be attended with peculiar advantages to the owners. Little pains however, are taken to plant maple orchards, or even to preserve the trees, where they grow spontaneously.*

* There is, perhaps, no tree which adorns our forest, so well deserving the attention of the philosopher and the philanthropist as the Acer Saccharinum, called in New England the rock maple. It is valuable not only for the quality of its juice, but it affords timber for many purposes far superiour to that of most forest trees, and for fuel, it is little if at all inferiour to the walnut. It flourishes best in moist and strong soils, but it is observed that those trees, which grow in dry land produce the sweetest juice, although somewhat less in quantity.

The farmers in New England in general, are so sensible of the value of this tree, that they preserve it, when clearing their forests. This practice, however, is not without its disadvantages. The tree shoots its roots to a very considerable distance, near the surface of the ground. Its top is large and foliage luxuriant. The consequence is, that when those trees with which it was interwoven, in its native state, are cut away, and the the maples are left defenceless against the strong winds, and sudden gusts, which are common during the summer months, they are liable to be overturned, and the roots adhering to and interwoven with the vegetation around them, the surface of the soil is turned up sometimes to the distance of fifteen or twenty feet from the body of the tree, and the land to that distance

Most families manufacture, in their houses, the greater part of their common cloathing, from flax and wool raised on their own farms, of an excellent quality."

MORSE.

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is spoiled, unless the trunk be seasonably cut off, and the stump allowed to turn back to a perpendicular position. If, however, instead of depending on the natural growth for a maple orchard, farmers would plant these trees in the most rocky, rough, and rugged parts of their farms, they would take root deep in proportion to their original exposure, and the daily agitations they experienced from the prevalent winds of the climate. The tops would be larger, and it is observed that trees with large tops yield the most juice *cæteris paribus*. They would, however, not grow so tall as in the forest, and the tops which give the wind its principal advantage for overturning the trees would be at the end of a shorter lever, and the trees would be very little if at all exposed to being blown over.

There are some peculiarities attending this tree, which deserve the attention of the philosopher. Dr. Williams in his justly celebrated NATURAL AND CIVIL HISTORY OF VERMONT, speaking of the *Acer Saccharinum*, observes:

" The manufacture of *maple sugar* is also an article of great importance to the state. Perhaps two-thirds of the families are engaged in this business, in the spring, and they make more sugar than is used among the people. Considerable quantities are carried to the shop keepers, which always find a ready sale and good pay. The business is now carried on under the greatest disadvantages: without proper conveniences, instruments, or works; solely by the exertions of private families, in the woods, and without any other conveniences than one or two iron kettles, the largest of which will not hold more than four or five pail fulls."

The great object, however, is to obtain the juice. We may have accommodations, more or less for evaporation, but where fuel is within reach, the process of boiling the sap will not be of much comparative importance.

Dr. Williams remarks that " while the trees are frozen at night, and thawed in the day, the sap runs plentifully: but as soon as the buds come on the sap ceases to flow in such a manner that it can be collected."

What can be the cause of its flowing best in alternations of frost and sunshine? Perhaps the frost and the thaw may be requisite in order to expand the pores of the wood. Perhaps in a clear day, such as generally follows a freezing night, with a northwest wind the air may possess greater weight and elasticity, and the tree being obliged, as it were to pump up, or what is the same thing, obtain by suction, the juices which serve to nourish it, is assisted by the weight of the atmosphere at such times as the atmosphere possesses the greatest weight and elasticity.

I have known the Rock Maple, when a northerly breeze was blowing, flow very briskly in the morning. If the wind shifted to the south or east, and the barometer fell as it always does in New England, very soon after such change, the tree would immediately cease to exude its juice. But if the season has been generally unfavourable, the tree will oftentimes, contrary to the general laws of its vegetation, yield a liberal supply of its juice at or near the close of what is

## MASSACHUSETTS.

There is a duck manufactory at Boston, at which between 2.000 and 3,000 bolts, of forty yards each, (worth about thirteen dollars per bolt) said to be the best duck ever seen in America, have been made in one year. Manufactories of this kind have been established in Salem, Haverhill, and Springfield. Manufactories of cotton goods have been attempted at Beverly, Worcester, and Boston, and much credit is due to the patriotick gentlemen who began them; although by their persevering exertions they have not been able to surmount the various obstacles in the way of success. A woollen manufactory, on an extensive scale, has been established at Byfield parish in Newbury. At Taunton, Bridgwater, Plymouth, Amesbury, Middleborough, and some other places, nails have been made in such quantities as to prevent, in a great measure, the importation of them from Great Britain. A machine for cutting nails has been invented by Mr. Jacob Perkins of Newburyport, a gentleman of great ingenuity in the science of mechanicks, which (if necessary) will turn out two hundred thousand nails in a day. The engines, which are worked by water, at Amesbury may be increased to any number that may be necessary. The nails, it is asserted by those who have tried them, have a decided superiority over those

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termed an unfavourable season, while the barometer is low, and the weather, as they say in New England, *southerly*.

I would here beg leave to protest against a practice, too common among the first settlers of our forests, of tapping the trees by what they in New England style "*boxing*." They often cut a large gap in the tree, and apply underneath a spout to convey the juice to the trough, or receptacle designed for it. But this "boxing" makes a wound not easily healed, and the trees after a few repetitions of such a practice decay, and yield no more juice. If, however, small orifices, or punctures, be made with a spike gimblet, a small augur, or what is called by some a tap borer, and an elder, or sumach stem, hollowed by shaving out the pith, and the ends nicely fitted to the orifices, be introduced into such orifices, a portion of the sap or juice may be obtained with very little injury to the tree. It would, perhaps, be advantageous, at the close of the season for manufacturing maple sugar to draw such quills, stems, or spouts from the trees, and fill the orifices with something like the medicated tar, described page or some other substance, which might be useful in healing the wounds which had been inflicted on the tree. T. G. F.

of English manufacture; and are sold twenty per cent. cheaper. The proprietors say they can make a sufficicnt number to supply the continent, Inventions of such extensive utility deserve the patronage of the publick.

In this state are upwards of twenty paper mills, six on Neponset river, seven on Charles river, one at Andover, on Shawseen river, one at Sutton, one at Worcester, another at Springfield; others have been lately erected at different parts of the state. Most of these mills have two vats each, and when in action, employ ten men and as many girls and boys, and produce at the rate of 70,000 reams of writing, printing, and wrapping paper annually. It was estimated in 1792, that 20,000l. worth of paper was yearly made by these mills. The quantity has since rapidly and annually increased.

In 1793 the principal card manufactories in Boston, belonging to Messrs. G. Richards, W. Whittemore, and M. Richards, made yearly about 12000 dozens of cotton and wool cards, which consumed nearly 200 casks of wire, averaged at 130 dollars per cask, and about 35,000 tanned calf, sheep, and lamb skins, at thirty seven cents each, the sticking of these cards employed not less than two thousand people, chiefly children, and above sixty men were fully occupied in manufacturing card boards, card tacks, and finishing the cards. Besides the above there were at that period three other smaller manufactories in Boston; and it is estimated that between 2000 and 3000 dozens of cards were made at the other manufactories in different parts of the state. The principal card manufactory is now at Cambridge (Menotomy parish) belonging to Mr. Whittemore, and the works are a great curiosity. At the close of the year 1801, it was etimated that on an average, fifty dozens were made in a day, exclusive of those made by machinery.

There are two or three manufactories, in Boston and its vicinity for making playing cards, at one of which large quantities are made.

Lynn, eight miles to the north-eastward of Boston, in the county of Essex, is the seat of the shoe manufacture; though a vast quantity are made in Boston, Quincy, Reading, Stoneham, Byfield, Newbury, and other places. It is not easy to fix the number of shoes annually made by the industrious inhabitants of Lynn: but by a calculation made in February, 1795, it appeared that two hundred master workmen, and six hundred journeymen and apprentices are constantly employed in this business, who make annually about 300,000 pairs of shoes, which are exported chiefly by the manufacturers to the southern markets. One man, Mr. B. Johnson, from his own workshop, in the course of seven months, shipped 20,600 pairs of shoes, valued at 4,956l. 6s. exclusive of large numbers sold in the vicinity.

Silk and thread lace of an elegant texture are manufactured by women and children, in large quantities, in the town of Ipswich, in Essex county, and sold for use and exportation in Boston and other mercantile towns. This manufacture, if properly regulated and encouraged might be productive of great and extensive advantages. In the year 1790, no less than 41,979 yards were made in this town ; and the quantity it is supposed has been since considerably increased.

A wire manufactory has lately been erected, at a considerable expense in Dedham, in Norfolk county, for the purpose of drawing wire for the use of the fish-hook and card manufactories in Boston. The essays which have already been made promise success.

There are several snuff, oil, chocolate, and powder mills in different parts of the state, and a number of iron works and slitting mills, besides other mills in common use in great abundance for sawing lumber, grinding grain, and fulling cloth.

There were in 1792, sixty-two distilleries in this state, employed in distilling from foreign materials. In these distilleries are 158 stills, which together contain 102,172 gallons. Besides these there were twelve country stills, employed in distilling domestick materials ; but these were small. One million nine hundred thousand gallons have been distilled in one year, which at a duty of eleven cents a gallon, yield a revenue to the government of 209,000 dollars. In the year ending June 30, 1796, 1,479,509 gallons were distilled in the state from foreign, and 11,490 from domestick materials, yielding a revenue of 148,769 dollars and thirty-six cents.

A brick pyramidical glass house was erected in Boston, by a company of gentlemen, in 1789. This has since been pulled down, and another erected on a new plan. For want of workmen skilled in the business, their works were not put in operation effectually till November, 1792: and have since been interrupted by the transformation of the building. The glass here manufactured is much superiour to any ever imported and finds a ready sale, being as cheap, according to its quality. There is manufactured about nine hundred sheets in a week, each sheet worth about one dollar and seventy-five cents; amounting per annum, to about seventy-six thousand dollars. As there is an abundance of the materials for this manufacture at command, there can be little doubt of its being carried to such an extent in the course of a few years, as to preclude foreign importations, which will make a vast saving to our country. Every friend to his country must wish that the patriotick company, which have established this manufacture, might meet with such success as to have their expenses reimbursed, which have been very great.

## BRIDGES IN MASSACHUSETTS.

Charles River Bridge, was built in 1786-7. It is 1563 feet long, and leads from Boston to Charleston. It has 75 piers, with a draw in the middle for the passage of vessels. Each pier is composed of seven sticks of oak timber, united by a cap piece, strong braces and girts, and afterwards driven into the bed of the river, and firmly secured by a single pile on each side, driven obliquely to a solid bottom. The piers are connected to each other by large strong pieces, which are covered with four inch plank. The bridge is forty-three feet wide, and has a passage of six feet width railed in for foot passengers. It has a gradual rise from each end, and is two feet higher in the middle than at the extremities. It is illuminated, when necessary by forty lamps. The draw requires but two men to raise it. At the highest tides the water rises twelve or fourteen feet; the floor of the bridge is then about four feet above the water. The depth of water in the channel is, at low water twenty-seven feet.

Malden Bridge across Mystick River, connecting Charlestown with Malden, was begun in April 1787, and was opened for passengers the September following. This bridge, including the abutments, is 2420 feet long and thirty-two feet wide. It has a draw of thirty feet wide. Its expense 5,300l.

Essex Bridge is upwards of 1500 feet in length, was erected in 1789, and connects Salem with Beverly. The expense of this bridge is said not to have exceeded one-third part of that of Charles River Bridge, and yet it is esteemed equal in strength and superiour in beauty to the former.

A bridge over Merrimack river was planned and constructed by Mr. Timothy Palmer of Newburyport, the architect in building the celebrated bridge over the Schuylkill, to be described hereafter, was built in 1792. The river is divided into two branches, at the place in which this bridge is erected. An arch of 160 feet diameter and forty feet above the level of high water connects this island with the main on one side. The channel on the other side is wider, but the centre arch is but 113 feet diameter. Great ingenuity is discovered in the construction of this bridge.

We shall pass over several bridges of less magnitude and end our sketch of the bridges in Massachusetts, with that which connects Boston with Cambridge. The wood part of this is 3,500 feet in length. The causeway, on the Cambridge side is 3640 feet, making together nearly one mile and a third. It is supported by piers, and has a draw for the passage of vessels, and is much the longest and one of the most expensive bridges in the United States.

A bridge which promised to be no ways inferiour to any abovementioned has been begun in order to connect the south part of Boston with Dorchester Point. We have not, however, learned whether it is completed, and are not able at this time, to give a particular description of its plan.

## MANUFACTURES IN RHODE ISLAND AND PROVIDENCE PLANTATIONS.

A cotton manufactory has been erected in Rhode-Island, in which the warps are spun by water, with a machine, which is an improvement on that of Arkwright; and strong, smooth, and excellent yarn is thus made, both for warps and stockings. The filling of the cotton goods is spun with jennies. In these several works five carding machines are employed, and a calender, constructed after the European manner. Jean, fustians, durins, thicksets, velvets, &c. &c. are here manufactured, and sent to the southern states. Large quantities of linen and tow cloth are made in different parts of this state for exportation. The most considerable manufactures in this state are those of iron, such as bar and sheet iron, steel, nail rods and nails, implements of husbandry, stoves, pots and other household utensils, the iron work of shipping, anchors, bells, &c. The other manufactures of this state are rum, spirits, chocolate, paper, wool and cotton cards, &c. besides domestick manufactures for family use, which in this, in common with other states, amount to a vast sum, which cannot be ascertained.

Iron ore is found in great plenty, in several parts of this state. The iron works on Patuxet river, twelve miles from Providence are supplied with ore from a bed four miles and a half distant. The ore pits are cleared of water by a steam engine, constructed and made at the furnace under the direction of the late John Brown, Esq. of Providence, which continues a very useful monument of his mechanical genius.

In Providence are two spermaceti works, a number of distilleries and sugar houses.

On Pawtucket falls in this state are three anchor forges, one tanning mill, one flour mill, one slitting mill, one clothiers' works, the shearing performed by water, three snuff mills, one oil mill, one cotton manufactory, three fulling mills, and two machines for cutting nails, all moved by water. Besides a machine for cutting screws, a furnace for casting hollow ware, and various forges.*

## MANUFACTURES IN CONNECTICUT.

We learn from Dr. Morse, that considerable attention has been paid in this state to the culture of silk, with a fair prospect of eventual success. A woollen manufactory has been established in Hartford, but is said to be on the decline. Mr. Chittenden of New Haven, about the year 1784, invented a machine for bending and cutting card teeth. This machine is put in motion by a mandril, twelve inches in length and one in diameter. Connected with the mandril are six parts of the machine independent of each other; the first introduces a certain length of wire into the chops of the *corone;* the second shuts the chops and holds fast the wire in the middle until it is finished; the third cuts off the wire; the fourth doubles the tooth in proper form; the fifth makes the last bend; and the sixth delivers the finished tooth from the machine. The mandril is moved by a band

* Morse.

wheel, five feet in diameter, turned by a crank. One revolution of the mandril makes one tooth; ten are made in a second, and 86,000 in an hour. With one machine like this, teeth enough might be made to fill cards sufficient for all the card manufactories in New England.

In New Haven are linen and button manufactories; and a cotton manufactory lately established on a large scale. In East-Hartford are glass works, a snuff and powder mill, iron works, and a slitting mill. Iron works are established also at Salisbury, Norwich, and other parts of the state. At Stafford is a furnace at which are made large quantities of hollow ware and other ironmongery. There are paper mills at Norwich, Hartford, New Haven, and in Litchfield county, and oil mills of a new and ingenious construction, in various parts of the state. Very great improvements have likewise been made in New Haven in the manufacture of fire arms, of which we have not yet been able to obtain a particular description.

*Turnpike Roads:* From Norwich through Plainfield to Providence; from Norwich through Lebanon to Colchester, &c. to Hartford; from Hartford, to Mansfield, Pomfret to the Massachusetts line, and thence through Dedham to Boston; from Hartford to Boston; from Hartford, through Berlin and Wallingford to New Haven; from New Haven to Litchfield, and from Litchfield to Hartford.

## MANUFACTURES AND AGRICULTURE IN THE STATE OF NEW YORK.

In the city of New York are manufactured wheel carriages of all kinds, and besides the more common manufactories there are those of loaf sugar, potters' ware, umbrellas, and musical instruments of different kinds.

Glass works and iron works have been established in various parts of the country. Works of this kind on a very extensive scale are situated ten miles west of Albany. They consist of one large new glass house, and one old one, a saw mill, pounding mill, and a cross-cut mill. The manufacturers live around these works, constituting a little village of about thirty houses. These works, with about 13,000 acres of land adjoining are the property of three enterprising, and publick spirited gentlemen. They work three furnaces, employ thirteen glass blowers, and make on an average, 20,000 feet of glass in a month, besides bottles and flint glass. The proprietors use kelp instead of pearl ashes in the manufacture of glass.

A society for the promotion of agriculture, arts and manufactures, was founded in New York, in the year 1791, whose researches promise to be of great publick utility. Of this society the following gentlemen were elected officers.

The hon. Robert R. Livingston, *president*,
The hon. John Sloss Hobart, *vice president*,
Alexander M. Comb, Esq. *treasurer*,
John M'Kesson, Esq. *secretary*.

There have been, in this state, some late attempts by a Mr. Fulton, to drive boats by steam, which I fear have not yet proved of much consequence. Boats constructed on similar principles were attempted to be driven on the Duke of Bridgewater's canal in England. The fuel and the machinery occupied so great a space that little was left for passengers and other purposes. Besides, in an open river, in a storm, one wheel may be out of water and the other have but a momentary and precarious hold, in consequence of the *heeling*, as mariners say, and rocking of the vessel.

I would, however, not wish to discourage further attempts to introduce navigation by steam, and have made these observations with the best will towards those who have attempted, or are willing to encourage essays of the kind.

## MANUFACTURES, &c. IN NEW JERSEY.

In Trenton, Newark, and Elizabethtown are a number of tanneries at which large quantities of leather are made, and a part of it exported to the neighbouring markets. In 1796, two hundred workmen were employed in Newark in the manufacturing of shoes, who annually made about 100,000 shoes. Iron works are erected in Gloucester, Burlington, Sussex, Morris and other counties. In the county of Morris are no less than seven rich iron mines, two furnaces, two rolling and slitting mills, and about thirty forges, containing from two to four fires each. These produce annually about four hundred and fifty tons of bar iron, 800 tons of pigs, besides large quantities of hollow ware, sheet iron and nail rods. In the whole state, it is supposed are made yearly about 1200 tons of bar iron, 1200 do. of pigs, 80 do. of nail rods, exclusive of hollow ware, and various other castings, of which vast quantities are made.

A powder mill was erected, early in the late war by colonel Ford, which afforded a timely supply of that article at a time when its importation was impossible.

In 1791 a manufacturing company was incorporated by the legislature of this state, with great privileges. A subscription for the encouragement of every kind of manufacture was opened under the patronage of the secretary of state, and the amount of 500,000 dollars was subscribed, and works were erected at the falls of the Passaick. The place in which these manufactures were set on foot was called *Patterson*, in honour of Judge Patterson, then governour of New Jersey. The proprietors were disappointed in their expectations. There are, however, existing in this place, some promising manufactories of cotton and paper.

A number of copper mines have been discovered in different parts of this state. One in particular situated between Hakinsak and Passaick rivers, near their junction has proved very valuable. This mine was discovered in 1729. By the year 1731, Mr. Arant Schuyler, their proprietor, had exported 1,386 tons of ore. The mines were neglected during the revolutionary war. In the year 1793, a company was formed for the purpose of working these mines, and it is said that their prospects in the concern are flattering. When pure copper was sold in England for 75l. sterling per ton, this ore was shipped for England at 70l. The ore produces above four ounces of silver to each hundred weight of copper. It is supposed that there are copper mines, worth exploring in Boundbrook, Pluckemin, Rockyhill, Woodbridge, and Brunswick.

A correspondent of Dr. Morse gives the following account of a copper mine at Brunswick :

" About the years 1748, 1749, 1750, several lumps of virgin copper, from five to thirty pounds weight, in the whole upwards of 200 pounds, were ploughed up in a field belonging to Philip French, Esq. within a quarter of a mile of New Brunswick. This induced Mr. Elias Boudinot, of the city of Philadelphia, to take a lease of Mr. French of this land, for 99 years, in order to search for copper ore, a body of which he concluded must be contained in this bill. He took in several partners, and about the year 1751, opened a pit in the low grounds, about two or three hundred yards from the river. He was led to this spot by a friend of his, who, a little before, passing by at three o'clock in the morning, observed a body of flame arise out of the ground, as large as a common sized man, and soon after die away. He drove a stake on the spot. About fifteen feet deep, Mr. Boudinot came to a vein of bluish stone, about two feet thick, between two perpendicular loose bodies of red rock; covered with a sheet of pure virgin copper, a little thicker than gold leaf. This bluish stone was filled with sparks of virgin copper, very much like copper filings, and now and then a large lump of virgin copper from five to thirty pounds weight. He followed this vein almost thirty feet, when the water coming in very fast, the expense became too great for the company's capital. A stamping mill was erected, when by reducing the bluish stone to a powder, and washing it in large tubs, the stone was carried off, and the fine copper preserved, by which means many tons of the purest copper were sent to England without ever passing through the fire; but labour was too high to render it possible for the company to proceed. Sheets of copper about the thickness of two pennies, and three feet square, on an average, have been taken from between the rocks, within four feet of the surface, in several parts of the hill. At about fifty or sixty feet deep, they came to a body of fine solid ore, in the midst of this bluish vein, but between rocks of a white flinty spar, which, however, was worked out in a few days. These works lie now wholly neglected, although the vein when left was richer than ever it had been. There was also a very rich vein of copper ore discovered at Rocky Hill, in Somerset county, which has also been neglected from the heavy expense attending the working of it. There have been various attempts made to search the hills beyond Boundbrook, known by the name of Van Horne's mountain but for the same reason is now neglected. This mountain discovers the greatest appearance of copper ore of any place in the state. It may be picked up on the surface of many parts of it. A smelting furnace was erected before the revolution, in the neighbourhood, by two gentlemen, who were making considerable profit on their work, until the British destroyed it in the beginning of the war. The inhabitants made it worth their while by collecting the ore from the surface and by partially digging into the hill to supply the furnace. Besides a company opened a very large shaft on the side of the hill, from which also a great deal of valuable ore and some virgin copper were taken. Two lumps of virgin copper were found here in the year 1754, which weighed, 11,900 pounds."

A lead mine has been discovered in a place called Hopewell, four miles from Trenton, and plaster of Paris has been found in the county of Sussex.

In the town of Newark and the one adjoining it on the north there are immense quarries of stone, of a very valuable kind, and much used in building. The quarries in Newark alone, it has been estimated, would now rent for 1,000l. a year, the number of workmen to be limited. Their value is annually increasing. A slate quarry has been lately discovered in Hunterdon county, within 300 yards of Delaware river, 75 miles above Philadelphia, which it is said promises to yield slate of a superiour quality to any that has been discovered in the United States, and equal to any imported from Europe. It has been purchased by Mr. James Bell, who contemplates opening it.

U. STATES GAZETTE.

An excellent bridge has been built across the Delaware at Trenton, thirty miles above Philadelphia. It was begun on the twenty-first day of May, under the direction of Mr. Burr. The abutment on the Pennsylvania side is fifty feet in front, and eighteen feet thick, with the back part supported by an horizontal arch. The stone work was commenced on the third day of July, in the same year. The fronts of the abutments from the surface of the ground, and the ends, and about forty feet of the wing walls above the banks, are carried up with cut stone in courses of range work: varying in depth as they proceed upwards from twenty to six inches, and *battering* half an inch in the foot, The work is in a style of simplicity but neatly executed. The cut stone in the abutments are clamped together with iron clamps to the greatest height of their exposure to ice and other floating substances, and in every tier of stone are a number of branch clamps, extending diagonally and crosswise the abutment, connecting the whole together. The interiour is composed of large rough stone, many of half a ton weight and upwards, filled in with smaller stone, and the whole laid in good sand and lime mortar, forming one entire solid mass of masonry. These abutments are nineteen feet above the ordinary flow of the tide, six feet above the highest freshes from ordinary causes, and at least four feet higher than the water has ever been known to rise, from obstructions by ice on the bars below. The travelling way is still nearly three feet higher; which prevents the possibility of any injury to the wood work by the highest freshes.

The wing walls on the east side, at sixty feet from the abutments spread seventy-eight feet. For the first twenty feet they run into the banks are laid as deep as the foundation of the abutment, and seven feet wide in the bottom. From the end of the angle they are continued in a parallel line with each other, one hundred and three feet further, on a gradual taper to four feet, where they terminate. The exteriour of this masonry is battered half an inch to the foot, while the interiour is straight, so that the filling has little or no pressure on the perpendicular walls, but will settle in perpendicular lines.

The wing walls on the west are eighty-five feet in length from the front of the abutments, extend about eighteen feet into the bank, and spread sixty-six feet—the width of the street leading to the bridge.

In laying the exteriour courses of the foundations of the piers, great care was taken to select flat and long stones, running many feet into the piers. On these and through the whole interiour, are laid large rough stones of great weight, and the whole closely filled in with building stones, The depth of these foundations varies several feet in different parts of the piers, owing to the irregularities in the rock, on which they are laid, which furnishes additional security against ice and other floating substances.

An offset of six inches is made on these foundations, when the cut stone commences, the pier here receives its proper shape and dimensions, which, in this place, is sixty-eight feet in length, and twenty-two in breadth, with the end up stream of a semicircular form. The levelling up of the foundation, and all the cut stone are laid in terras mortar. On the pier next to the Pennsylvania shore, three courses of cut stone are laid, rising above the foundation to the height of four feet seven inches. On each of the other piers one course only of cut stone is laid, of twenty and twenty-two inches in depth: in which situation ice and every other floating substance will run over them during the spring and winter seasons.

The span between each of the piers on the Pennsylvania side, is one hundred and ninety-four feet. From the New Jersey abutment to the first pier, the span is one hundred and fifty-six feet: the water way nine hundred and thirty-two feet, out of eleven hundred, the width of the river.

The piers are carried up with cut stone, tapering as they proceed upwards from twenty-five to eight inches, until they rise to the top course, which is twelve inches, with the sides and lower end battering half an inch in the foot. These stones extend into the body of the work, from eight inches to five feet. The exterior or cut stone, as high as the water has ever been known to rise, is laid in terras mortar; and throughout the whole extent, lengthways, every second or third course clamped together with iron clamps. Crosswise also of the piers, every third or fourth course, eight or more iron cramps are extended from the side, and let into courses of cut stone. These, together with a vast number of branch clamps, it is presumed will effectually secure the whole from spreading or giving way in any direction. The ends of the piers, up stream, are semicircular, and after rising four and a half feet from their foundations, with the usual batter of the sides, they recede or batter at an angle of sixty-seven degrees, until they rise to the further height of ten perpendicular feet, when they are again carried up with the former batter to the square, where they terminate, and receive their finish, with a capping of cut stone, in the form of a half dome. The stones of which this angular part is composed, are all deep in their bed, extending from two to five feet into the pier, and are each secured with a clamp of iron. At this point the cut stone ceases, and the dimensions of the piers are here sixty-two feet in length, and twenty in breadth.

An offset of eight inches is then made on the sides, and the squares of the piers again carried up, with a skew back, to the further height of three feet nine inches. The feet of the arches rest on this offset, and spring from this angle. The height of the piers next the shores from the foot of the arches to ordinary low water mark, is twenty-seven feet six inches each. The distance between the abutments is one thousand and eight feet, and the whole length of the bridge, including the wing walls one quarter of a mile.

The stone work consists of one hundred and sixty-nine thousand, two hundred and fifty perches of masonry.

The managers speak in terms of the highest eulogy of the execution of the masonry of this bridge, and from the observations which the editor has made he believes with them that a more solid and complete structure cannot be found in the United States.

## AGRICULTURE, MANUFACTURES, BRIDGES, &C. OF PENNSYLVANIA.

The use of plaster of Paris is very common in this state, and has proved highly beneficial in some soils. A tract which conveys much valuable information on this subject was published in 1797, by the hon. Richard Peters. The mode which was adopted by the author of obtaining correct information respecting the operation of this manure was extremely well calculated for that object. A number of queries relative to the operation of this powerful manure were sent to some of the principal agriculturists in this and some of the neighbouring states, and their answers inserted in this tract together with some very judicious observations of the author. At the close of the book are inserted a number of miscellaneous observations which are well worth the attention of all concerned in the cultivation of the soil.

The writer, from the result of a great number of experiments, which appear to have been carefully made and accurately noted, concludes gypsum to be a "whimsical and capricious substance." He says that he "has known it produce no effect for four years, and then throw up a most astonishing vegetation ; and this after repeated ploughings, for both summer and winter crops."

One fact, however, has been observed by judge Peters, which perhaps explains the true theory of the action of gypsum, and leads us to a knowledge of its extraordinary fertilizing properties. Whatever be the cause he observes, that "*dew* will remain on a part of a grass field plastered an hour or two in the morning, after all the moisture is evaporated from the part of the same field not plastered. I have also frequently seen this effect upon garden beds, which if plastered will retain moisture in the driest season, when there is not the least appearance of it in those beds whereon no plaster was strewed."

From this and many other appearances and facts, which tend to explain the operation of this extraordinary substance, it would seem very evident that gypsum attracts moisture from the atmosphere. On cold and moist lands, and even on any species of soil not extremely arid, in a wet season gypsum may exhibit too powerful an affinity for water to be serviceable to vegetation.

Pennsylvania is about on a par with her sister states, with respect to agricultural improvements. The farmers in general are not prone to theorising or making experiments in husbandry. Wheat, several varieties, Indian corn of different species, barley, oats, spelts, buckwheat, turnips, with several species of grasses,* such as are common to most parts of United America, compose their principal articles of different field culture. Stone buildings are common among farmers in this state, but stone fences are rarely to be found.

An improved mode of constructing barns is adopted in this state. The most perfect model of such improvement is said to be found in a barn of Mr. Samuel Gibson, an intelligent farmer of Kingsess, which is thus described in the American edition of Dr. Rees's Cyclopædia. The construction of a barn sufficient to accommodate a well cultivated farm of 120 acres, 40 of which may be supposed woodland, is as follows.

" The situation should be as near the middle of the farm as can conveniently be, and on ground sloping toward the south, so as to admit of water being brought through wooden pipes, from the ground above, and raised in the yard, if practicable, or at least that it may pass through the yard. The scits should not be nearer than sixty, and not further than a hundred yards from the dwelling house, as in case of fire breaking out in either, the other may be safe: it also conduces more to cleanliness, and where any of the family may happen to be sick they will not be disturbed by the noise of the barn, stables, &c. The dimensions might be seventy

* For a more particular account of these grasses consult the work of Dr. Mease above quoted.

feet by thirty-six; the hill to be dug into, upon a level, and the earth removed to form the barn yard. The building to be of stone, the foundation sunk two feet below the level; the walls two feet and a half thick at bottom, and to continue so to the height of the stable floors; the ground so much sloped as to be five feet high where the hill is cut down, and a wall raised close to this, at the distance of seven feet from the barn, this intermediate space would admit a free circulation of air round the barn and stables below; over this a gangway is to be raised, leading into the barn floor; an excavation may also be made into the hill, under this, to which a door through the aforesaid wall may conveniently lead, which will form a very suitable place for the stowing away potatoes and other vegetables. The stables to be seven feet in the clear; and the wall, two feet thick, set right on the middle of the wall below. From that to the square of the barn the thickness may be reduced three inches on each side, and carried up twenty feet above the stables. Above this the gable ends may be raised fifteen feet, which will give sufficient slope to the roof, which ought to be covered with the best cedar shingles or slate. The ground area below may be divided into four spaces for cattle, horses, &c, none of which divisions ought to be less than twelve feet wide, with one entry between the two rows of creatures, whose heads should be towards the entry. The foundations of the partitions a stone wall eighteen inches thick, rising ten or twelve inches at least above the floor, on which a frame of wood work should rise to the joists. The stable floors, paved with pebble stones, descending from the troughs; with a like descent towards the door. The advantages of such a floor are, that it will not harbour rats and other vermin, and is durable; the hardness ought to be no objection, as plenty of bedding should be furnished, for the purpose of increasing the quantity of dung. Raise the barn floor seven feet above the bottom of the haymow, which will leave twelve feet for the height of the barn floor, which ought also to be its breadth. The advantages of raising it thus are many: the labour of pitching your hay is very much reduced; you acquire a good room between that and the stables for stowing grain, &c. The labour of raising the entrance to the barn floor is trifling in comparison with the labour of pitching it would otherwise occasion; and if the ground rises with a considerable angle, backwards, the difficulty of raising the gangway will be still less. The barn floor should be laid with three inch oak plank, well seasoned: each plank ploughed with a half inch iron, within an inch of the lower edge, and a strip put in each joint, which will keep the whole completely firm and solid, and effectually prevent dust, &c. from getting through; it might also be an advantage to have glass windows in the granary and back of the barn floor, the sides of which may be defended by the boards, which form the sides of the granaries next the hay-mows and ought to rise four feet above the threshing floor. Fixed ladders above the barn floor are also convenient to get at the hay above. In each hay-mow a square hole of four feet must be run up, from the entry below to the top of the mow, and framed to prevent the hay from stopping it up. These will serve a two-fold purpose, that of conveying hay to feed with and as ventilators. It may also be observed, that the stable and entry doors ought all to be arched, and the hinges and fastenings of all the doors, of iron, built into the wall, in the simple form of hooks and eyes, the hook making part of the hinge, the stable floor should also be as high as the sill of the door, and ascending back.

Round stone pillars two and a half feet in diameter may be raised at equal distances from each other in front of the stables, and eight feet apart, these may be made as high as the stable doors, upon which a frame might be erected to such a height as to be conveniently covered by the general roof; which would form an excellent corn house, and would also shade the stable doors. Steps should be placed under this frame, leading into it, and also into the granary under the barn floor. This frame or corn house, should be so high from the ground as to admit a cart or wagon below it; and should also have an opening in the floor, to pour the corn down. The main entry to the corn house to be through the threshing floor.

A barn built upon these principles would produce a saving of at least one hand daily, in the single article of pitching hay, as one man may haul and tumble into the barn as much hay as three would stow away in the usual way, which is of considerable consequence in harvest time, when work is pressing. One man will pitch the hay from the wagon, on the barn floor, up to the whole square of the barn, as fast as two or three can stow it away; whereas, in the common way of building barns, it would take two to pitch it up. Indeed it might be questioned whether it would not be an advantage to raise the floor still higher, on this account, as pitching hay is the hardest part of stowing it away; this would also increase the size of the granaries. To this some might object, on account of its rising above the square of the barn, but this is nothing when put in competition with the advantages to be derived from the facility of pitching, as the roof may readily be formed so as to admit of it.

Objections have been made against stone barns, as not being sufficiently airy, and being damp, so as to injure the grain; inconveniences more imaginary than otherwise, and which the writer of these observations has never experienced; but which if they did exist might soon be remedied, by plastering the outside of the north east end of the building, and projecting a penthouse from the square, which, if attended to, and a sufficient number of windows left, all of which that are under the eves, and otherwise not exposed, having Venetian blinds, with a large ventilator on the top of the roof, on which may be fixed a lightning rod; such precautions will most assuredly prove the superiority of such a stone barn to all others."

In Philadelphia, together with numerous other societies and associations, an account of which it would be foreign to our plan to give, are the *American Philosophical Society*, *for the encouragement of manufactures and the useful arts*, and the *Society for the Promotion of Agriculture.*

The American Philosophical Society was founded in the year 1769. Its officers are one patron, one president, three vice presidents, one treasurer, four secretaries, and three curators.

The members are elected by ballot on the third Friday of the months of January, April, July, and October, and in order to such election at least twenty members must be present. This society has published some volumes of "*Transactions*," in which some very scientifick and useful treatises have been presented to the publick.

The Society for the promotion of Agriculture have not yet made publick their proceedings, although we are informed that they have that measure in contemplation.

*The Philadelphia Manufacturing Society* is of recent origin. By their constitution the capital stock of the company shall consist of 50,000 dollars, to be divided into shares of fifty dollars each. Five dollars are to be paid at subscribing, and the remainder in regular instalments. In case of non-payment of the instalments the delinquent forfeits his share or shares to the use of the company, together with what sum he may have previously paid.

A general meeting of the stockholders of the company is to be holden on the first Wednesday of January every year, fifteen days notice being previously given in the publick papers.

The affairs of this company are under the superintendance of nine managers, who elect one of their number president of the association. They propose to apply by petition to the state legislature for an act of incorporation.

*Bridges*. Those which are most worthy of notice are the Schuylkill bridge at the west end of Market-street, one over the same river at Reading, those over the river Lehigh at Bethlehem, Weis's ferry, and one near its discharge into the Delaware. We shall attempt a description of the first mentioned only.*

The Schuylkill which washes the western front of the city of Philadelphia, although it affords great advantages, had long been attended with many serious inconveniences. The frequent interruption of passage by ice and floods, and the ineffectual and uncertain mode of crossing heretofore practised, had for a long course of years, employed the thoughts and attention of many ingenious and publick spirited members of the community. The character of this river is wild, and in times of floods, rapid and formidable: and to any structure of slight materials, ruinous and irresistible.

Its borders, to an extent of one hundred miles, are skirted by precipitous mountains and hills. Its tributary streams, suddenly filled, in seasons of rains or melting snows, with the torrents rushing down their sides, without notice, or time for precaution, fill the river

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* This account is abridged from a very interesting and well written "Statistical Account of the Schuylkill Permanent Bridge," published in the Port Folio, commencing March 12, 1808.

with frequent floods, which no common works of art within their reach have heretofore been capable of withstanding. Although these attributes are not to a certain degree uncommon, yet, in this river, they are peculiarly dangerous. They occur at irregular periods, and often at seasons of the year when floods are generally unexpected. These circumstances, at all times, created doubts of the practicability of any permanent erection. The depth of water, opposite the city, added to the difficulties and apprehensions. The expense, in the early periods of its establishment precluded any plan, requiring large expenditures by those who then inhabited Philadelphia. In March, 1723, a law was enacted by the governour, Sir William Keith, and the general assembly, for the purpose of establishing a ferry over the Schuylkill, at the end of High street, Philadelphia. Tolls were then established, which the present rates do not in any case far exceed ; and in many cases, i. e. for country produce and manure, they are liberally reduced.

In December 1776, when the British troops had overrun the state of New Jersey, a bridge was composed of ship carpenters' floating stages, built by general Putnam at the suggestion of Richard Peters, Esq, which the defeats of the British auxiliaries at Trenton rendered unnecessary for military purposes. This, however, gave the first idea of the floating bridges over the Schuylkill, composed of buoyant logs.

A bridge was constructed by the British army in 1777, on pontons, or large boats. This, however, not fully answering their purpose, another was built of floating logs, after the pattern of the one which succeeded the bridge of stages. One of the pontons used by the British was sunk, and remained deposited on the bottom in such manner as to cause very great obstructions in the way of two piles of the *coffer dam*, sunk for the erection of the western pier of the present permanent bridge. This boat was sunk in 1777, in twenty-eight feet water below low water mark, and was found to be perfectly sound in 1802. The obstruction which it presented to the completion of the coffer dam was the cause of an extra expense of four thousand dollars.

After stating a number of projects which were proposed, but rejected as impracticable or impossible, the writer of whose labours we avail ourselves in forming this article, proceeds:

"In theory, it seems reconcilable with principles, that an arch of wood or iron, may be extended to any length of span, with sufficient elevation. The point of either practicability or discretion, has never been precisely fixed. In a modern proposal for a single arch of iron, over the Thames, in place of old London bridge, a project is exhibited for an arch of 600 feet span. All agree in the theory, but practical men shrink at the danger; though there are respectable opinions of intelligent theorists, in favour of its principles. According to the best opinions of practical men here (among them Mr. Weston and Mr. Palmer) one of two hundred feet begins to be critical and hazardous. The timber arch of Piscataway bridge, erected by Mr. Palmer, spans 244 feet; but he declared he would not again attempt one of similar extent. The most intelligent among those who have gained experience in the late structure, believe that the plan intended for the Schuylkill, in the last project, the draft whereof has been often seen by them, was too extended for *this spot;* and that it would most probably have failed. The weight of transportation here is uncommon and constant, and the friction of course incessant. Strength, symmetry, and firmness, are required here; of which one very extended arch is incapable. Although wood or iron may be so framed, as to have the least possible *drift* or *lateral thrust*, on the abutments or piers, yet there is a point beyond which it is dangerous to pass. Of stone or brick it would be adventurous, beyond all common discretion to risk an arch of such a span. Nor is the undulatory motion of an extensive arch, however composed, an unimportant objection.

A bridge of so extended a span must have been (to be safe) so much more elevated, that the filling would have pressed the walls too dangerously. Some relief might have been given by culverts, or reversed arches, to save filling; but these are not without their disadvantages. The pressure on the walls of the present western abutment and wings, is quite as much as masonry on piles will bear; and no other foundation could have been had, but at an unwarrantable expense, the rock at the scite of the abutment, being covered with mud and gravel 30 to 40 feet deep. It was deemed and found prudent, to sink the whole frame of the present structure, three feet into the piers, and imposts of the abutments, as well to avoid over-weight of filling, as to depress the platform, or travelling floor, to a point easy of access. An approach of the abutments, for an arch of 400 feet span, would have created a necessity (not known when such a plan was proposed) for coffer dams, and all their dangers and expense. The present bridge enlarges the passage for the water at least a fifth. One for an arch of 300 to 350 feet, would have diminished it in a greater proportion; because the abutments must have approached each other, so as to occupy the position now open, through the land or side arches.

"No persons engaged in such difficult works, should risk any project to save expense of foundations, for piers or abutments. But on the other hand, coffer dams should be avoided, if any other means can, with common prudence, be adopted. Their expense is enormous, and their success not always to be ensured. The great proportion of the expenditures in the Schuylkill bridge, has been incurred by the inevitable necessity for coffer dams.—The labour applied, and the difficulties encountered and overcome, will appear to the best informed engineers, uncommon and singularly arduous, as will appear by the short account of them subjoined to the present statement. Every effort was made to avoid the necessity of these dams, but on duly weighing all the projects suggested, none could be adopted with any prospect of safety. The irregularity of the bottom, and depth of water, at once were found to forbid the use of batterdeaus. Floats were thought of, composed of a platform of logs, on which masonry should be formed. These were to be built on, with logs at the sides, and others crossing the whole, bolted like wharves; filled in with masonry, and raised on as they sunk, till having lodged on the bottom, they should compose the foundation for masonry, from low water mark. But no horizontal, or solid position could be obtained for them. All the objections to batterdeaus lay against them. A flood too, might have carried them off in an unfinished state. This was proved, when a few of the belts of the coffer dam (light and buoyant, compared to these floats, and more easily secured) were swept away by a summer fresh; though they had been supported by some piles, and moored with anchors and cables, capable of holding a stout frigate. The levelling the bottom, or making one artificially (as was done by Semple at the Essex bridge in Dublin) was found impracticable, on account of the thick cover (13 feet) of mud in some parts, and the total bareness and unevenness of the rock in others. It became a choice of difficulties; and the coffer dam, or no bridge, was the alternative. Projects easily and cheaply to be accomplished in shallow streams, with level bottoms, or those capable of being artificially made so, were all found impracticable, and to the last degree imprudent here. The modes pursued in New England, either of piles, wharves, log frames, or stones loosely thrown into the stream, were considered and condemned. The destruction of many of the bridges of that country was predicted; but with a hope that this apprehension might prove unfounded, as the enterprises of the people there were admired and applauded. Sounds, or arms of the sea, sheltered from violent storms, broad rivers, capable of holding piles, and affording extensive flats, for overflows and waste of floods, will admit of slighter foundations, though always exposed to danger, under uncommon circumstances. Many of the sites of eastern bridges are of this description.

The general wish of the stockholders, at the commencement of the project, was strongly in favour of a stone bridge. A draft of a stone structure, elegant, plain practicable, and adapted to the site, with very minute and important instructions for its execution, was furnished to the president gratuitously, by William Weston, Esq. of Gainsborough in England; a very able and scientifick hydraulick engineer, who was then here, and from friendly and disinterested motives, most liberally contributed his professional knowledge and information, to promote the success of the company. The foundations of the present piers and abutments, were laid nearly according to his plan, though circumstances compelled a considerable departure from it, as the work advanced. His communications were attended to with great advantage, wheresoever they could be applied. Having viewed the inefficiency of the eastern coffer dam—in the same spirit of liberality, he furnished the president, a draft for the western coffer dam, before his departure for England. This plan was original, and calculated for the spot on which it was to be placed. It was faithfully and exactly executed under the care of Samuel Robinson, who was then superintendent of the company's work in wood. Mr. Weston foresaw great risks and difficulties, arising from the peculiar character of the river, and the nature of its bottom, in so great a depth of water. He declared, that he should hesitate to risk his professional character on the event, though he was convinced that the whole success of the enterprise depended upon, and required, the attempt. Some ideas of its magnitude may be formed, when it is known that 800,000 feet (board measure) of timber were employed in its execution, and the accommodations attached to it. Sufficient in quantity for a ship of the line.

But it was soon discovered that the expense of erecting a stone bridge, would far exceed any sum, the revenue likely to be produced would justify. For this reason alone, no further progress was made in the stone bridge plan. And though some other drafts, among them a very elegant one by Mr. Latrobe, were presented, the board of directors were under the necessity of returning them, as being objects, however desirable, too expensive to be executed with private funds. It was therefore concluded to procure plans of a bridge to be composed of stone piers and abutments, and a superstructure of either wood or iron.—Mr. Weston at the request of the president and directors, sent from England (after viewing most of the celebrated bridges there, and adding great improvements of his own) a draft of an iron superstructure, in a very superiour style; yet with his usual attention to utility, strength, and economy, accompanied by models and instructions. Although highly approved, it was not deemed prudent to attempt its execution. All our workmen here, are unacquainted with such operations; and it was thought too hazardous to risque the first experiment.

The casting can be done cheaper here, than in England, and with metal of a better quality, though the amount of the erection would in the whole, far exceed one of wood. Mr. Weston's draft is preserved, and may yet be executed in some part of the United States; and it would do honour to those who could accomplish it. Finally, the plan so successfully perfected was agreed to; having been furnished by Mr. Timothy Palmer of Newburyport in Massachusets, a self-taught architect, who was employed to execute the work of the frame. He brought with him Mr. Carr, as his second, and four other workmen from New England. They at once evinced superiour intelligence and adroitness, in the business, which was found to be a peculiar art, acquired by habits not promptly gained, by even good workmen in other branches of framing in wood.—But the materials and workmanship of this frame, are allowed to be remarkably faultless and excellent. It is also an evidence of prudence, in the president and directors, in selecting a plan already practised upon, and workmen accustomed to its execution.

Previous to the decision upon the superstructure, the *piers*, without a certainty of the stability whereof, no superstructure could be attempted, were begun; with the intent, that when their completion was ensured, the stockholders might be justified with confidence to proceed in the work. There being no general engineer, the president and directors were under the necessity of paying more attention, than is usually required in such cases. The president, with the assistance of a building committee, undertook the charge of the execution of this arduous work, requiring much attention as well in the outline as in its minute details.

The president suggested, with the approbation of the committee, important parts of the plans of the masonry, and modes of securing the dams; and several improvements in the plan of the frame, which were adopted by Mr. Palmer; and occasioned a material difference from those in New England, and elsewhere, erected on similar principles.

The president's proposition and general design of the cover, were approved and reported by the committee. The opinions of a very great proportion of the Stockholders were at first opposed to this measure; though when perfectly understood, it was unanimously agreed to. Its novelty excited doubts and apprehensions, which time, and many violent assaults from storms, have proved to have been groundless. It will long remain an example for future similar undertakings; and is the only covered wooden bridge in the world, a much inferiour one over the Limmat, in the north of Europe, excepted.*

Mr. Adam Traquair has merit in the draft of the cover, which he assisted to delineate. It was executed with singular fidelity and credit, by Mr. Owen Biddle, an ingenious carpenter and architect of Philadelphia; who made additions to the design. He published an

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* This was before the Trenton bridge was completed.

architectural work, entitled "The Young Carpenter's Assistant;" useful as an elementary guide, and which should be encouraged as an American production. In it will be seen a plate of this bridge, and a concise account of it; some parts whereof are herein repeated.

The whole of the masonry was performed by Mr. Thomas Vickers, who possesses not only integrity and practical skill, but is firm, constant, and prudently bold in hazardous undertakings. His exertions were conspicuous on every emergency and casualty attending the dams, and other dangerous and difficult parts of the work.

Those who, with the president, composing the building committee particularly, as well as the other members of the board, and the treasurer, meritoriously afforded every requisite assistance; as well when their aid was necessary in the executive business, as in a laudable attention to its pecuniary affairs. It always happens in such associations, that some pay more attention, and thereby gain and apply more useful intelligence than others.

It would be unpardonable, not to mention the stockholders, with high approbation. Their advances have been great, and their patience under privations of profit truly commendable. The amount of expenditures is nearly 300,000 dollars, though the dividends will be made on a much less sum (about 218,000 dollars) owing to the application of the floating bridge tolls, to the expense of the building. The company have evidenced a praiseworthy mixture of publick spirit, with a justifiable desire of pecuniary advantages; in which it is to be ardently wished, they will not be disappointed. Although these advantages may be delayed, they are ultimately secured. Not the least gratifying, must be the satisfaction arising from the accomplishment of a publick improvement eminently beneficial, at well in its use as its example, not only to those, who now enjoy its accommodation, but to posterity.

Few would have persevered under all the difficulties attending this work; which in its execution (unavoidably protracted by the embarrassments attendant on building under water) occuped six years after the law was obtained. However humble the merit of those who engage in such undertakings may be considered, they are far greater contributors to the happiness and convenience of mankind, than those who, with victories and triumphs, dazzle while they desolate, and ruin and oppress the human race.

DESCRIPTION OF THE BRIDGE.

The masonry is executed on a plan suggested to the mason, uncommon, if not new. The walls of the abutments and wings, are perpendicular, without buttresses, and supported by interiour offsets. These are found completely competent to support the pressure of the filling (which gravitates in perpendicular lines) without battering or contreforts. The abutments are eighteen feet thick.

The wing walls nine feet at the foundations, retiring by offsets, till at the parapets, they are only eighteen inches. The eastern abutment and wing walls are founded on a rock. Those on the western side are built on piles. The inclined plane of approach to the bridge, is elevated at an angle of three and a half degrees.

Although the western pier has attracted most attention, that on the eastern side of the river, was first erected; and was attended with difficulties appearing often insurmountable. It is from twenty-one to twenty-four feet deep, below the tide, to the rock, on which the lower course is laid and bolted. The coffer dam was on a bad plan, though constructed as well as that plan admitted. Its materials were too slight and incompetent. Constant exertion, and repeated remedies for defects, were incessantly called for by frequent accidents. Every thing was new to all employed; but it was a school to teach experience. The footing of the piles was secured, and the dam saved from impending destruction, by an embankment of stone and sand, thrown around the bottom on its outside; and the latter washed in, and consolidated by the current. The same means were used at the western dam, and their utility decidedly proved. Both piers are of course similar in their general configuration and composition. The first stone of the eastern pier was laid September 5th, 1801. That of the western pier, December 25th, 1802. The time preceding was occupied in procuring plans, gaining information, and providing materials. These precautions (always essential in great undertakings) forwarded the work, and ensured against delay and disappointment.

The frame is a masterly piece of workmanship ; combining in its principles, that of king posts and braces, or trusses, with those of a stone arch. Half of each post, with the brace between them, will form the *vousseur* of an arch ; and lines through the middle of each post, would describe the radii or joints. There are three sections of the frame, all similar. That in the middle divides the space into two equal parts, so that passengers in opposite directions, are prevented from interfering with each other.

The platform for travelling rises only eight feet from a horizontal line, and the top, or cap pieces, are parallel to this. Of the sections, the middle one has the most pressure, owing to the weight of transportation, being thrown nearer to that section than towards the sides ; to which the foot-ways prevent its approach. These foot ways are five feet in width, elevated above the carriage ways, and neatly protected with turned posts and chains. It has been conceived that the foot ways would have been more advantageously placed on each side the middle section, to throw the weight of transportation to the sides of the bridge.

Mr. Palmer (who is believed to be the original inventor of this kind of wooden bridges) permitted with much candour, considerable alterations in the plan, accommodatory to the intended cover, the design whereof is original. These were so much approved by him, that he considers the Schuylkill bridge superstructure the most perfect of any he has built. It was finished in one season ; and declared open for passengers and transportation, on the first day of January, 1805.

The Schauffhausen bridge (which is now destroyed) much eulogised in Europe, was by no means equal to that on the Schuylkill. Any candid and intelligent architect, on inspecting the drafts of the one, examining the other, and the principles of both, would give a decided preference to the latter. The design of this is more simple, its strength is greater, its parts are better combined, and more assistant to each other : and there is no useless timber in any part.

The timber of which both the frame and the cover are composed (the roof, of cedar excepted) is of the best white pine.

The flooring of the platform is doubled, and in the whole five and a half inches thick. The under course of white pine, three inches thick, is permanent, and well spiked and secured. The upper course is of sap pitch pine, slightly attached, two and a half inches thick, to be renewed as often as worn, either partially or generally, and with this the joints are broken. This mode of planking has been found, on the floating bridges highly advantageous and economical. The under course admits of two or three removals of the upper, which wears before it decays. The floorings of wooden bridges are generally of single planks.

The *exterior of the cover* is handsomely ornamented and painted. The under work imitative of stone, is well executed, by dashing the paint while fresh, with sand and stone dust. This is performed with so much ease and cheapness, that it is hoped it will introduce a like mode of ornamenting and protecting the surface of other wooden elevations. All apprehensions of scaling by frost, are proved to be imaginary.

A number of conductors, properly disposed, secure the superstructure from danger by lightning.

All that could be spared for ornament, was expended on the exterior; as the interior neither admitted nor required it.—The pediments of the entrances were intended to be finished with emblems of Commerce on the east; and of Agriculture, on the west. They are designed, and were to be executed, by that eminent American naval sculptor, William Rush of Philadelphia; whose works as an artist, are admired, in whatever part of the world they are seen. It is desirable that this *finish*, the expense whereof will be small, should yet be added. The pediments require it, to complete the design.

## GENERAL OBSERVATIONS.

The Schuylkill bridge plan may be varied according to circumstances; and its principles preserved. In whatever varieties, projectors of other designs may indulge themselves, it is confidently believed that Mr. Palmer's plan will be found on long experience, to be the best. It is a unit in symmetry and movement; and all its parts support each other, like a *phalanx in tacticks*. In some instances Mr. Palmer has placed the platform for travelling, over the cap pieces and cross ties; or rather these latter become part of the frame of the platform. The great body of the frame is of course below. But this was not found eligible, where ice and floods were likely to assault the haunches, when the frame was thus depressed. The elevation of the abutments would require, for this plan, immense weight and expense of filling, and expose the walls to dangerous pressure.

Nor would it be so well calculated for heavy transportation. More important than all—it would be unfit for *covering* to such advantage. Notwithstanding this great improvement, was highly approved by Mr. Palmer it was not in his contemplation, as to *mode*, until the outline of the present cover was shown to him : although he said he had repeatedly, but fruitlessly, urged the measure of covering their bridges, in New-England. It is hoped this example will be followed in all pontifical wooden structures of magnitude, hereafter. Bridges may, for most situations, be less expensive in the frame ; the middle section may be omitted above the flooring ; nor need they be more than thirty feet wide. This width was deemed sufficient by Mr. Weston, for bridges in general ; though he considered that over the Schuylkill to require more than common space, for its constant and burthensome transportation. The Easton bridge, built under Mr. Palmer's directions, is 28 feet wide; and the frame of the middle section does not rise above the platform. Its situation does not demand a plan, or call for dimensions, on a greater scale ; and it is erected according to the *improved* work of the frame of the Schuylkill bridge.

Although the cover of the Schuylkill bridge compelled ornament, and some elegance of design, lest it should disgrace the environs of a great city ; these would not be necessary in such a degree, in other situations. Neatness of elevation and taste in design, may be shown at a small expense ; and the workmanship and materials need be no more costly, than those for roofing and weather-boarding common frame buildings. The Schuylkill bridge roof required one hundred and ten thousand shingles, of three feet long and six inches wide ; and other materials in proportion. Much of these may be saved, in narrower frames. The painting or coating, with the durable composition, in imitation of stone, which appears on the exterior of the work, below the platform, (for which a recipe is subjoined) may be done at a small expense.—Mineral paints are the worst, for coating exposed to weather. The oil does not combine with the mineral, as it does with absorbent earths: and being extracted by the sun, leaves the mineral particles without adhesion, and they drop, or are washed away by rains, dews, and moisture. All oils or fats, are known, chymically, to be alike composed; and are better or worse, as they are or are not mixed with foreign matter. Linseed oil may be had every where, and fish oil is common. Ochres for colouring (far preferable to minerals) abound throughout the country; and only require judicious exploration for their discovery. Clarified turpentine is a good substitute for oils; but a mixture of both is best. The less *forcing*, to accelerate drying, the better. Though inconvenient in some respects, the composition will be more durable, the longer it is in drying; but care should be taken, that it be not so thin as to *run;* or not retain the sand and paint. Sea sand, or earth mixed with marine salt, should be avoided, as being hostile to compositions or cements; and particularly when calcareous substances are combined. Some of the Delaware stone-cutter's sand, used with the Schuylkill bridge coating, was found to be liable to this objection. We have daily before us proofs of this fact in our plastering; where the hair of salt hides is used. Every moisture of the room, or atmosphere, brings out stains and damp spots on our walls, to which papering will not adhere, as it does on other plastering, into the composition whereof, salt hair does not enter. Chymists may account for this: but to them it is not yet clearly ascertained, whence the muriatick acid is derived; nor are its nature, and properties, accurately known.* Long and frequent experience has evinced that the least mixture of this acid, or common salt,† with gypsum, produces a tertium, which renders it un-

* This acid forms, with calcareous matter, muriat of lime; which being deliquescent, will not indurate. Its strong affinity for water, attracts and retains the humid vapour of the air.

† Common salt is compounded of the muriatick acid, and soda. The latter substance abounds in the ocean, and other places, where common salt is found. The vitriolick acid of gypsum meeting with the muriatick, in the salt, expels it from the soda of the salt; and having a predominant affinity, forms sulphat of soda, or glauber salts. Good common salts should contain two thirds of soda, and one third muriatick acid; and is seldom pure in its combination as to proportion; or absence of foreign matter.

fit for a cement; and also destroy its agricultural uses and properties.

RECIPE FOR COMPOSITION TO IMITATE STONE.

The work should not be primed; though part of that at the bridge was so done, before it was determined to coat it with composition.

The paint used was common white lead and oil; as the painters preferred their own way, and the scaffolding could not remain at risk, while experiments on other paints were tried. It was conceded afterwards, that if there had been time to prepare and use other paint, and the urgency of despatch had not precluded delay for drying, fish oil and clarified turpentine with ochres would have been more eligible.

As fast as the painter proceeded in his work, an adroit hand dashed on the sand and pounded stone dust. This was mixed in proper proportions, as to colour and consistency, which is only to be known by preparatory experiments, easily accomplished. It was thrown on with a common tin dust pan. The sand and stone dust must be free from moisture, or any tincture from marine salt. It was dried in the sun or a large iron kettle over a slow fire. A small proportion of plaster of Paris, was mixed with the sand and stone dust. A long trough containing the sand and dust, was placed under the work; and caught what did not adhere, so as to be thrown up again and prevent waste. The despatch with which this operation can be performed, exceeded expectation, both as to facility and economy. With marble dust, it may be made to imitate that stone. As soon as one coat is dry the other must be laid on. Two coats, well attended to, are sufficient. But this is left to the choice of those, who think another coat is required.

The joints are imitated by convex strips, sprigged on the weather-boarding: and after the coating is put on, they are penciled off, with white paint.

The following is a recipe much followed, and with invariable success, for barns and other buildings in the country: and being particularly applied to roofs, it is called "*fire proof.*"

Take twenty gallons of fish oil; boil it four hours over a slow fire; and skim it as the feculence rises. Put in it twelve pounds of rosin, or an equivalent proportion of clarified turpentine. Before taking off the fire, mix ten gallons flax-seed oil, boiled in the common way. Grind and mix with the oil, a sufficient quantity of ochre (of what colour you please) to make the paint *thick* as can well be brushed on. As you brush on the paint, have your composition ready to sift, or dash on. It is thus made:

Take one bushel of ground plaster, calcined over a fire in a dry pot, or kettle. When cold, mix with it three bushels of stone dust or fine sand, dry, and the more gritty or siliceous, the better. Sift or dash on, as fast as the paint is laid on. When dry, the second coat is applied in the same manner. Live coals, in quantities, have been thrown on roofs thus coated, without injury. It does not scale with frost, or melt with the hottest sun. The above is sufficient for a large roof.

The whole expense of the preceding composition including labour and laying on will not exceed 50 dollars.

| | Feet. | In. |
|---|---|---|
| Length of the bridge, - - - | 550 | |
| Abutments and wing walls, - - - | 750 | |
| Total length, - - - - - | 1300 | |
| Span of small arches - - - - (three in the whole number, including middle arch.) | 150 | |
| *Ditto of middle arch, - - - - | 194 | 10 |
| Width of the bridge - - - - | 42 | |
| Curvature of the middle 12 } The curvatures are catenarian. | | |
| ditto of small arches 10 } | | |
| Rise of the carriage way, - - - | 8 | |
| Height in the clear over carriage way, - | 13 | |

* The middle arch was originally intended to be only 160 feet, but the dam could not be placed on the spot contemplated, owing to the barreness and inequalities of the rock at the bottom.

It is highly creditable to those concerned in the direction and executive branches of this work, that no delay ever occurred through want of supplies, or prompt payment. Yet one million and a half of feet (board measure) of timber, and above 22,000 perches of stone, with all the subordinate and auxiliary materials required, were employed in this structure. The labour, the cost whereof was a great proportion of the expenditures, was obtained below the common rate, in most instances; owing to the regularity and certainty of payment.

| | Feet | In. |
|---|---|---|
| Height from surface of the river to the carriage way, - - - - - - | 31 | |
| Depth of water to the rock at the western pier | 41 | |
| Ditto at the eastern pier, - - - | 21 to 24 | |
| Amount of toll when the work began for 1799, | $ 5000 | |
| Present rate (1805.) - - - - | 13000 | |

The company have established commodious wharves, which were necessary for the safety of the abutments ; and add greatly to the improvements of that front of the city.

*President and Directors at the close of the Work.*

*President*, Richard Peters.
*Directors*, John Dunlap, John Perot, Ebenezer Hazard, Thomas Savery, William Poyntell, Charles Biddle, Richard H. Morris, George Fox, Peter Browne, John G. Wachsmuth, George Reinhold, Anthony Cuthbert.
*Treasurer*, John Dorsey.
*Building Committee*. Richard Peters, William Poyntell, Anthony Cuthbert, John Dunlap, Peter Browne, George Fox.

*Quarries of excellent marble* are found in this state of different colours, white, blue, varigated, and black. They are situated on the Schuylkill, in Montgomery county, and in Centre county. Slate is also procured in large quantities, on the Lehigh river near the coal mines before mentioned.

ARTIFICIAL MINERAL WATERS.

A manufactory of these waters has been lately established in Philadelphia, which promises to be not only lucrative to the proprietors, but of great publick utility. Some idea of their importance may be obtained from the following article, which is transcribed from that highly and justly celebrated periodical publication, the Port Folio.

" Sometime, we believe, in the year 1766, an enterprising individual by the name of Owen, opened, what he denominated a mineral water warehouse, which he attempted to make a fashionable *lounge*, by assuring the nobility, gentry, and the whole tribe of valetudinarians, that he would, by a chymical process, rival the waters of the most famous springs on the continent, as well as in Great Britain. Whether from the rage of repairing to Pyrmont and Spa, and Bath and Buxton, or whether from some defect in his processes, we believe this project of Owen, though plausible, was never fully realized. About the year 1792, a swiss adventurer, and a very ingenious chymist, by the name of Schweppe, manufactured these waters, by a process so scientifick and successful, that the artificial water in many respects was demonstrated to be superiour to that from the fountain head. Since that period, what is denominated Seltzer and Soda waters have become not only as common remedies in many alarming disorders, but as grateful morning beverage to those who are curious in their choice of fluids, or who, as it is incomparably better expressed by Shakspeare, are *exquisite in their drinking*.

" We remark with very great pleasure, that an establishment of this useful nature, has lately been made in this city. Soda, Seltzer, Pyrmont, and Ballstown waters, are furnished at the manufactory at a reasonable rate, and appear to possess many valuable properties. Some of the most learned of our physicians and chymists, together with many private gentlemen, have born open testimony to the efficacy and agreeableness of these waters, and we have not a doubt, that as soon as their peculiar properties become more generally known, that they will be often quaffed by the luxurious, the studious, the sedentary, and the hypochondriacal.

" As information on this subject is much wanted and as it is a vulgar errour to suppose that these waters are merely a nauseous medicine, we have from a very new and valuable work, by Sir John Sinclair, entitled " The Code of Longevity," extracted the subsequent account of Mr. Schweppe's process. The testimony of the above ingenious physician who describes it is above all challenge, and Dr. Beddoes, whose profoundness as a chymist, will hardly be denied, has declared that such are the invigorating effects of what he terms *mineral acid*, that it may be often very advantageously substituted for fermented or vinous liquors.

" From unquestionable authority, we are assured that these waters are, in London, not only copiously supplied from the laboratory of the chymist, but also from the bar of the tavern. The invalid, tormented by dyspepsia, or any of its distressing symptoms, is sure to find relief in this salutary beverage; and the *bon vivant*, whose oppressed stomach is acid by libations of port over night, is effectually cured by a glass of Soda in the morning. At the most luxurious tables, Seltzer and Madeira are often mingled, and this union of Bacchus with the Naiads, is not less propitious to pleasure than to health. The celebrated Sir James Mackintosh, who was once as famous for his convivial, as he always is for his literary powers, tired or afraid of the *bewitching smiles of Burgundy*, has wholly relinquished the use of wine, and finds no abatement in his social or his studious powers while he drinks a purer stream from the bowl of chymistry.

"In the year 1795, that respectable physician, Dr. Pearson, of Leicester square, London, drew up at the desire of the author, the following hints respecting water impregnated with fixed air, or the carbonick acid, as manufactured by J. Schweppe, late of Geneva.

"Three years ago, a person of the name of J. Schweppe, late of Geneva, called upon Dr. Pearson with a letter of introduction, to propose making those artificial mineral waters, which contain a large proportion of carbonick acid, or fixed air.

"On examining the waters prepared by this artist, the Doctor found that they contained a much larger proportion of carbonick acid than he had ever seen before. Mr. S. manufactures these preparations at an expense, which most persons will think reasonable, and in any quantity that may be required by the publick.

"The advantages of water so impregnated, are, that at all times, in our country, may be prepared a water equal, or even superiour in all respects, to Pyrmont, Spa, Paulon, and other springs, whose virtues depend solely on the quantity of carbonick acid air they contain.

"2. A still greater advantage is, that by the means of water so highly impregnated, alkalies can be exhibited with much greater benefit than in any other way and in adequate quantities, so as to be not only not disagreeable, but highly grateful both to the stomach and palate.

"3. This preparation affords a most agreeable beverage either with or without the alkaline salt, according to the palates.

"4. Such a beverage must be highly useful in many diseases, as it can now be prepared in a far superiour manner and at a less expense than heretofore.

" 5. Such a beverage is highly salutary to the common way of living in this country, as when mixed with wine it is found that a much smaller quantity of wine satisfies the stomach and palate, than wine does alone.

" 6. It is highly beneficial as a drink in the evening, to take off the acid, apt to be produced in the stomach after wine and full meals, to dilute the fluids, when containing too much irritating matter, to carry off such stimulating matter, and to strengthen the stomach. It is here supposed that the water contains alkali.

" Upon the whole, when we consider the effects of water impregnated as it is by M. Schweppe, with carbonick acid, and with alkali, both as a medicine and an article of *salutary luxury*, it may be justly *reckoned the greatest improvement in diet of the present age.*

" To many persons languishing under disease, the following information may be peculiarly acceptable though it cannot be expected that in every case the proposed remedies should answer.

" *Seltzer water* from its pleasant taste and medical virtues, has been long in very general use. It has been very much recommended by physicians for its antiseptick powers, consequently for its utility in many of the febrile and other diseases of large towns. It is a powerful antiscorbutick. In bilious complaints it is particularly useful by correcting the acrimony of that fluid and assisting the tone of the stomach and bowels, by which pain and irritation are obviated or removed. In nervous affections it is useful, by invigorating the general system, exalting the spirits and removing weakness. To the ill effects whether nervous or bilious, which take place, as the debilitating consequence of hard living, it is peculiarly adapted. It is most refreshing and salutary after excess in eating and drinking by allaying the feverish heat and thirst generally arising therefrom.

" By gently stimulating the nerves of the stomach it increases digestion, prevents flatulencies, and promotes the secretions in general, particularly that of the kidneys.

" With milk it is a very useful remedy in consumptions. making the milk sit easy on the stomach. In most of the stages of the catarrh, or common cold, either in the head or lungs, it may be taken with great utility. With wine or syrup, it affords a most wholesome and agreeable beverage.

" It is one of the safest as well as most cooling drinks for persons exhausted by much speaking, heated by dancing, or when quitting hot rooms, or crowded assemblies. It may be taken in the quantity of a common beer glass at a time."

Mr. Joseph Hawkins, who introduced the manufacturing of these waters into Philadelphia, has made a very important improvement in the process. The mineral water by machinery of his contrivance, and for which he has obtained letters patent from the government of the United States, is raised from the fountain or reservoir in which it is prepared under ground, through perpendicular wooden columns, which enclose metallick tubes, and by turning a cock at the top of the columns, the water may be drawn either in large or small quantities, and may be drunk at the fountain without the necessity of bottling. The reservoir being placed under ground, and frigid preparations occasionally made use of, the mineral water is rendered more cool, refreshing and grateful to the taste. The fixed air is likewise better retained in that mode of manufacturing and drinking these waters than in the mode hitherto customary, in which much of this air, which give the waters that lively and in some degree pungent taste so pleasing to the palate, is suffered to escape both in corking the bottles and drawing the corks when the water is drunk.*

Much commendation is likewise due to Mr. George Shaw, the present partner of Mr. Hawkins, who by his industry and capital has put this manufactory on a flourishing establishment.

A very valuable coal mine has been discovered on the Lehigh river, in the county of Northampton. Dr. Woodhouse has favoured the publick with the following account of the properties of this coal, published originally in the Philadelphia Medical Museum.

" This coal is found in immense quantities in Pennsylvania, in the county of Northampton, near the river Lehigh. It is of a shining black colour, and stains the hands very little. Its fragments are tabular as may be

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* We are requested to inform the publick that these waters are prepared and sold under the direction ot the persons who first introduced them into this country, at the house of George Shaw, by Shaw and Hawkins, No. 98, Chesnut street, Philadelphia, where the different kinds may be obtained in any quantity, either for home consumption or exportation.

These gentlemen likewise contemplate imitating all the natural mineral springs of any celebrity which have been discovered in the United States.

seen very particularly after it has been submitted to heat. Its specifick gravity is 16,181. It burns with very little flame, and no smoke; it is with some difficulty kindled, and requires a considerable draught of air to keep up its combustion. When perfectly consumed, it leaves behind a small portion of siliceous earth, containing no potash, and sometimes coloured brown, by means of iron. It does not contain any sulphur.

" A fire was kindled at half past eleven o'clock, by placing a quantity of the Lehigh coal, upon a stratum of common charcoal in a powerful air furnace, which was then filled with equal portions of the two substances.

" As fast as the charcoal consumed, the Northampton coal was added, and at half past one the furnace was completely filled with it, and two thirds of it red hot. At four o'clock the coal was half consumed, and it continued burning until eleven o'clock at night.

" James river coal submitted to an experiment of the same kind, burned out in four hours.

" A fire was made with the Lehigh coal in a smith's forge, and two thick bars of iron were placed in it, and welded with great care, by the proprietor of the furnace.

" The smith, his journeymen, and by-standers were convinced that the heat was much greater than that of James river coal.

" As the Virginia coal burns with flame and much smoke, a vast portion of this combustible substance, and the heat generated by it, is lost in passing up the chimney.

" The Lehigh coal promises to be particularly useful, when a long continued heat is necessary, and in distilling or evaporating large quantities of water from various substances; in the melting of metals, or in subliming of salts; in generating steam to work steam engines; and in common life, for washing, cooking, &c. *provided the fire places are constructed in such a manner as to keep up a strong draught of air.*"

## DISTILLERIES.

Of these there are a great number in various parts of the state. But we know of none, which claims any notice on account of any particular improvements in the process of distillation, excepting that of colonel Anderson of Philadelphia. For these improvements this gentleman obtained a patent, which specifies that his invention consists in "making use of steam, arising in distillation for heating wash, or any subject to be distilled, by means of a condensing tub in which the wash is so placed as to receive the whole heat of the steam." This process saves fuel and labour, and renders it impossible to burn the wash. Two stills constructed on this principle are in operation at Lamberton, at the works of Messrs. Anderson and Hall, and we understand they are about to be introduced into various other parts of the country.

In the city of Philadelphia and its immediate vicinity, there are ten ropewalks, thirteen breweries, six sugar-houses, seven hair powder manufactories, two rum distilleries, one rectifying distillery, three card manufactories, several iron founderies, in one of which are cast cannon of a large calibre, fifteen for earthen ware, six for chocolate, four for mustard, three for cut nails, one for patent nails, one for steel, one for aqua fortis or nitrick acid, one for sal ammoniack and glauber salts, several for oil colours, two for brushes, two for buttons, one for morocco leather, one for parchment, several for the manufacturing of glue, besides gun makers, type founders, ship builders, plumbers, and a great variety of others.

*Shot manufactories* have lately been established or revived, and appear to promise to supersede the importation of English shot. They are manufactured principally from lead found in Louisiana and shipped from New Orleans.

These shot are not equal to the English patent shot,* having in general a minute cavity on one side, but they

* Patent shot, as Dr. Black has informed us, are manufactured in England as follows:

"A little orpiment or arsenick is added to the lead, which disposes it to run into spherical drops much more rapidly than it would do when pure. The melted lead is poured into a cylinder, whose circumference is pierced with holes. The lead streaming through the holes soon divides into drops, which fall into water, where they congeal. They are far from being all spherical, however, many being shaped like pears and must be picked. This is done by a very ingenious contrivance. The whole is sifted on the upper end of a long, smooth inclined plane, and the grains roll down to the lower end. But the pear-like shape of the bad grains make them roll down irregularly, and they waddle as it were to a side; while the round ones run straight down. They are received into a sort of funnel, which extends from the one side of the inclined plane to the other, and is divided by several partitions, so that it is really the mouth of several funnels which lead to different boxes. Those in the middle receive the round grains.

are sold at a lower rate, and will answer all the ordinary purposes of the sportsman.

## STEAM ENGINES.

There is no part of the world in proportion to its population, where a greater number of ingenious mechanicks may be found than in Philadelphia and its immediate vicinity. Steam engines with all their various improvements are built and applied, beneficially, to the most useful purposes. There are two of these in Philadelphia, which belong to the corporation of the city, built for the purpose of supplying the city with water; one of which likewise drives a rolling and slitting mill.

In the Philadelphia steam engines certain innovations have been introduced, which we hope may be found to

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On each side are grains of a worse shape, but good enough for low priced shot. The grains which have gone far aside are melted again. The good ones are sorted into sizes by sieves.

The grains of small shot made in this way are very often hollow, or have a deep pit on one side, which is frequently rugged within; it is owing to the sudden congelation of the outside by the water. That forms a hard case, while the interiour is still fluid; and contracting as it cools, a part is left empty. As this greatly lessens the value of small shot, many attempts have been made to prevent it, which have been more or less successful. Some manufacturers have mixed other metals with the lead, others have kept oil on the water; others receive the lead into boiling hot water covered with melted tallow. I believe that the most successful method has been that of the manufacture in Southwark, London, where the furnace is at the top of a very high tower, not less than one hundred feet, and the shot is gradually cooled as it falls through the air. The chief effect of this, however, must be the incomparably greater number of spherical grains. I do not see how this will much prevent the hollowness of the shot, even if the tower were four times as high. The shot would fall two hundred and fifty feet in four seconds, and four hundred feet in five seconds, neither of which would sufficiently cool it. Its latent heat requires a much longer time than this for its absorption by air. The pear-like shape is occasioned by the fluid lead within breaking the crust, and freezing as it comes in contact with the water. When this is done from a very small height, the drops descend slowly through the water. The fluid within breaking the crust by its great weight, runs out freezing as it goes down, and often leaves a pretty round thin cup with a taper thing below it like an extinguisher. Some metals thus form themselves into nails with large heads; others take other shapes very uniform, and very unexpected. Great differences are produced by different liquors instead of water, and by different heats of the metals, and by the heights from which they are poured, &c.

See likewise Nicholson's Journal, vol. 1. page 263. Rep. of Arts, vol. 2. and Parke's Chymical Catechism, Philadelphia edition, pages 214. 272. 282.

be improvements. What are styled the improvements, consist, principally, in making use of a wooden chest to contain the water, through which the flues of the furnace wind several times before their discharge into the chimney.

These wooden boilers are supposed to be serviceable in consequence of their being slow conductors of heat, and the long cylindical heaters exposing a very great surface of iron to the action of the water. The steam engine in Center Square is a double steam engine, with a cylinder of thirty-two inches. Its power is calculated for supplying not merely the present but the future wants of this city. It makes twelve strokes of six feet per minute, for sixteen hours in twenty-four, in which time it consumes from twenty-five to thirty-three bushels of Virginia coals of the best sort.

Some inconveniencies are said to attend these wooden boilers, such as steam leaking through the joints and at the bolts. A conical wooden boiler has been adopted as it appears at the suggestion of Mr. Oliver Evans, with hoops, which promises every wished for success. It was found that a combination of oak and pine in the same boiler was liable to premature decay in consequence of the pine being acted upon by the acid of the oak.

At the lower engine, next the Schuylkill, which is a double steam engine of forty inches cylinder, and six feet stroke, a cast iron boiler has been put up with straight sides and semicircular ends; seventeen feet long and eight feet wide at the bottom; nineteen feet long and ten feet wide at the height of five feet seven inches. At this height it is covered by a vault, which in its transverse section is semicircular, and in its longitudinal section exhibits half its plan. The bottom is concave every way, rising one foot in the center. The fire place is six feet long and four feet wide on an average, and is under one extreme end of the bottom. The firebed is arched, parallel with the bottom, and a space of one foot left for the passage of the flame. The flame by means of flues and an arch of bricks is made to pass several times through and round the boiler. The boiler is composed of seventy plates of iron, cast with flanches and bolted together, so that the flanch and bolts are within the water, and is tied together by numerous braces. This boiler consumed fifty bushels of coals and one half cord of wood while rolling iron twelve hours at twenty strokes a minute.

Certain improvements are likewise made in the construction of the condenser of this engine. These consist in so contriving the condenser that the water of condensation is evacuated twice in every stroke of the piston; which by creating a more perfect vacuum adds to the power of this engine.

Mr. Oliver Evans, of Philadelphia, has devoted much time and made great improvements in mill machinery, steam engines, and other branches of mechanicks. A tract of which he is the author, entitled "The young mill-wright's and miller's guide," is the only treatise written in America, which we have seen devoted to the purpose of enabling the young mechanick to understand the theory as well as practice of the useful arts which he professes.

His work is divided into the following five parts:

I. Mechanicks and Hydraulicks, showing errours in the old, and establishing a new system of theories of water mills, by which the power of mill seats, and the effects they will produce may be ascertained by calculation.

II. Rules for applying the theories to practice, tables for proportioning mills to the power and fall of the water and rules for finding pitch circles, with tables from 6 to 136 cogs.

III. Directions for constructing and using all the author's patent improvements in mills.

IV. The art of manufacturing meal and flour in all its parts, as practised by the most skilful millers in America.

V. The Practical Mill wright; containing instructions for building mills, with tables of their proportions suitable for all falls from three to thirty-six feet; with an Appendix, containing rules for discovering how improvements made may be exemplified in improving the art of cleaning grain, hulling rice, warming rooms and venting smoke by chimneys, &c.

This work is perhaps calculated rather for the tyro in mathematicks and mechanicks, than for one who had made very considerable improvements in those branches of science. Still we believe it to be very useful, particularly that part which gives a description of Mr. Evans's Patent Elevators.

Mr. Evans has made a liberal but judicious use of the writers, (particularly Smeaton,) who have preceded him in this very important branch of mechanical philosophy. From the attention which it has been in our power to bestow upon his tract, and his inventions and improvements, we are convinced that they deserve much more encouragement than they have received.*

The following extract from the Specification of Mr. Evans' patent for a new mode of working machinery by steam of a high temperature, together with the specification for improvements in mill machinery, we present the publick with the consent of the inventor, and hope giving it publicity may have a tendency to cause the improvements of Mr. Evans to be still more generally adopted, and prevent others from infringing upon his patents.

" My principle is to construct engines so as to confine the steam and thereby increase the heat in the water, which increases the elastick power of the steam to a very great degree : applying the following principle in nature not heretofore used or known to be useful in moving machinery, namely : As the heat of the water is increased in an arithmetical progression, the elastick power of steam is increased in a geometrical progression. Every addition of about thirty degrees of heat in the water (by Fahrenheit's thermometer, be the temperature what it may) doubles the elastick power of the steam, which is in so great a ratio that doubling the heat in the water increases the power of steam about one hundred times. The precise ratio is unknown, and perhaps never can be ascertained. This principle never can be put in practice fully equal to the theory, because if we consume double the quantity of fuel it will not create double heat in the water ; but in practice it

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* Mr. Evans makes the following complaint of the propensity of Americans to stifle a spirit of improvement, which I am sorry to find corroborated by too many instances of unjust and injurious treatment to those whose ingenuity has been of incalculable service to their country and to mankind.

" The ingenious inventors of useful improvements in this country, are still left to struggle, not only with the taunting sarcasms and embarrassing opposition of those who, wise in their own conceit, apparently take delight in condemning and opposing projects until they are brought into successful operation, but with heavy losses and sometimes ruin, even if the attempt succeeds. Nine tenths of the exclusive rights granted will injure the inventor for the first fourteen years in this country, especially if the patent be taken out before the improvement is in full operation ; and if not till then some pilfering genius may attempt surreptitiously to take out a patent for the principles of the invention before the true inventor, and occasion him the heavy expense of a lawsuit before his right can be established.

appears that as the consumption of fuel is increased in an arithmetical progression, the effect of my engines increase in a geometrical progression also, in so great a ratio, that doubling the consumption of fuel increases the effect of the engine at least sixteen times.

"The application of this principle is what I claim as the principal part of my discovery, invention, and improvement, on steam engines, and this is wherein my engines differ from all others heretofore known or used. My principle will apply to move all steam engines of every form and construction, provided their several parts be sufficiently strong to bear the power of the steam to put the principle in action, working the engine by the elastick power of the steam alone, but a condenser may be used to take off the resistance of the atmosphere.

## THE FOLLOWING IS MR. EVANS'S SPECIFICATION FOR IMPROVEMENTS IN MILL MACHINERY.

"My first principle is to elevate the meal, as fast as it is ground, in small separate parcels, in continued succession, and rotation, to fall on the cooling floor, to spread, turn, and expose it to the action of the air as much as possible, and to keep it in constant and continual motion, from the time it is ground until it be boulted: this I do to give the air full action; to extract the superfluous moisture from the meal, while the heat generated by the friction of grinding will repel and throw it off and the more effectually dry and cool the meal fit for boulting in the course of the operation, and save time and expense to the miller; also to avoid all danger from fermentation by its lying warm in larger quantities than usual; and to prevent insects from depositing their eggs, which may breed the worms, often found in good flour. And further to complete this principle so as to dry the meal more effectually, and to cause the flour to keep sweet a greater length of time, I mean to increase the heat of the meal as it falls ground from the mill stones, by application of heated air; that is to say, to kiln dry the meal as it is ground, instead of kiln drying the grain as usual. The flour will be fairer and better than if made from kiln-dried grain, the skin of which is made so brittle that it pulverizes and mixes with the flour. This principle I apply by various machines which I have invented, constructed, and adapted, to the purposes hereafter specified, numbered 1, 2, 3, 4, 5.

My second principle is to apply the power that moves the mill or other principal machine to work my machinery, and by them to perform various operations, which have always heretofore been performed by manual force, and thus greatly to lessen the expense and labour of attending mills and other works.

"The application of those principles, including these of kiln drying the meal during the process of manufacture or otherwise to the improvement of the process of manufacturing flour, and for other purposes, is what I claim as my invention and improvement in the art, as not having been known or used before my discovery, knowing well that the principles once applied by one set of machinery to produce the desired effect, others may be contrived and variously constructed and adapted to produce like effects in the application of the principles; but perhaps none to produce the desired effect more completely than those which I have invented and adapted to the purposes, and which are herein after specified.

"No. 1. *The Elevator.* Its use is to elevate any grain, granulated or pulverized substances. Its use in the manufacture of flour or meal is to elevate the meal from the millstones in small separate parcels, and to let it fall through the air on the cooling floor, as fast as it is ground. It consists of an endless strap-rope, or chain, with a number of small buckets attached to thereto, set to revolve round two pullies, one at the lowest and the other at the highest point between which the substance is to be raised. These buckets fill as they turn under the lower, and empty as they turn over the upper pulley: the whole is inclosed by cases of boards to prevent waste.

"No. 2. *The Conveyor.* Its use is to convey any grain, granulated or pulverized substances in a horizontal ascending or descending direction. Its use in the process of the art of manufacturing flour, is to convey the meal from the mill stones as it is ground to the elevator, to be raised, and to keep the meal in constant motion, exposing it to the action of the air; also in some cases to convey the meal from the elevator to the bolting hopper, and to cool and dry it fit for boulting instead of the hopper boy No. 3, also to mix the flour after it is boulted; also to convey the grain from one machine to another, and in this operation to rub the impurities off the grain. It consists of an endless screw, set to revolve in a tube or section of a tube, receiving the substance to be moved at one end, and delivering it at the other end; but for the purpose of conveying flour or meal I construct it as follows: instead of making it a continued spiral, which forms the endless screw, I set small boards called flights at an angle crossing the spiral line, these flights operate like so many ploughs following each other, moving the meal from one end of the tube to the other, with a continued motion turning and exploring it to the action of the air to be cooled and dried. Sometimes I set some of these flights to move broad side foremost, to lift the meal from one side to fall on the other, to expose it to the air more effectually.

"No. 3. *The Hopper Boy.* Its use is to spread any grain, granulated or pulverized substances, over a floor or even surface; to stir it and expose it to the air to dry and cool it when necessary, and at the same time to gather it from the circumference of the circle it describes, to or near the centre, or to spread it from the centre to the circumference, and leave it in the place where we wish it to be delivered when sufficiently operated on. Its use in the process of manufacturing flour is to spread the meal as fast as it falls from the elevator over the cooling floor on the area of a circle from eight feet to sixteen feet more or less in diameter, according to the work of the mill, to stir and turn it continually, and to expose it to the action of the air to be dried and cooled, and to gather it into the boulting hoppers, and to attend the same regularly. It consists of an upright shaft made round at the lower end about two thirds of its length, and set to revolve on a pivot in the centre of the cooling floor; through this shaft, say five feet from the floor, is put a piece called the leader, and the lower end of the shaft passes very loosely through a round hole in the centre of another piece called the arms, say from eight to sixteen feet in length—this last piece revolving horizontally, describes the circle of the cooling floor, and is led round by a cord, the two ends of which are attached to the two ends of the arms, and passing through holes at each end of the leader, so that the cord will serve to pull each end of the arms equally. The weight of the arms is nearly balanced by a weight hung to a cord which is attached to the arms and passes over a pulley near the upper end of the upright shaft, to cause the arms to play lightly, pressing with only part of their weight on the meal that may be under it. The foremost edges of the arms are sloped upwards to cause them to rise over and keep on the surface of the meal as the quantity increases, and if it be used separately and unconnected with the elevator, the meal may be thrown with shovels within its reach, while in motion, and it will spread it level and rise over it until the heap be four feet high or more, which it will gather into the hoppers, always taking from the surface, after turning it to the air a great number of times. The under sides of these arms are set with little inclining boards called flights about four inches apart next the centre, and gradually closing to about two inches next the extremities, the flights of the one arm to tract between those of the other they operate like ploughs, and at every revolution of the machine they give the meal two turns towards the centre of the circle near to which is generally the boulting hoppers. At each extremity of the arms there is a little board, attached to the hindmost edge of the arm to move side foremast; these are called sweepers; their use is to receive meal as it falls from the elevator and trail it round the circle described by the arms that the flights may gather it towards the centre from every part of the circle, without these this machine would not spread the meal over the whole area of the circle described by the arms. Other sweepers are attached to that part of the arms which pass over the boulting hoppers to sweep the meal into them.

" But if the boulting hoppers be near a wall and not in the center of the cooling floor, then in this case the extremities of the arms are made to pass over them, and the meal from the elevator let fall near the centre of the machine, and the flights are reversed to turn the meal from the center towards the circumference, and the vampers will sweep it into the hoppers. Thus this machine receives the meal as it falls from the elevator on the cooling floor, spreads it over the floor, turns it twice over at every revolution, stirs and keeps it in continual motion, and gathers it at the same operation into the boulting hoppers and attends them regularly. If the boulting reels are stopped, this machine spreads the meal and rises over it, receiving under it from one to two and three hundred bushels of meal, until the boults are set in motion again, when it gathers the meal into the hoppers; and, as the heap diminishes, it follows it down, until all is boulted. I claim, as my invention, the peculiar properties, or principles, which this machine possesses; viz. the spreading, turning, and gathering the meal at one operation, and the using and lowering its arms by its motion, to accomodute itself to any quantity of meal it has to operate on.

"4. *The Drill.* Its use is to move any grain, granulated or pulverized substance from one place to another. It consists, like the elevator, of an endless strap, rope, or chain, &c. with little rakes instead of buckets (the whole cased with boards to prevent waste) revolving round the pullies or rollers. Its use in the process of manufacturing flour is to draw or rake the grain or meal from one part of the mill to another; it receives it at one pulley and delivers it at the other, in a horizontal, ascending, or descending direction, and in some cases may be more conveniently applied to that purpose than the conveyor. I claim the exclusive right to the principles and to all the machines above specified, and for all the uses and purposes specified as not having been heretofore known or used before I discovered them. They may be all united and combined in one flour mill, to produce my improvement on the art of manufacturing flour complete, or they may each be used separately for any of the purposes specified and allotted to them, or to produce my improvement apart according to the circumstances of the case.

"No. 5. *The Kiln Dryer.* To kiln dry the meal after it is ground, and during the operation of the process of manufacturing flour, I take a close stove of any common form and enclose it with a wall made of the best non conductor of heat, leaving a small space between the stove and the wall to admit air, to be heated in its passage through this space. I set this stove below the conveyor that conveys the meal from the mill stones as ground into the elevator, and I connect the space between the stove and the wall to the conveyor tube by a pipe entering near the elevator, and I cover the conveyor close and set a tube to rise from the end of the conveyor tube near the mill stones for the heated air to ascend and escape as up a chimney. I make fire in the stove and admit air in the bottom of the space between it and the wall round it to be heated and pass along the conveyor tube meeting the meal which will be heated by the hot air and the superfluous moisture will be more powerfully repelled and thrown off, and the meal will be dried and cooled as it passes through the operation of the elevator and hopper boy. The flour will be fairer than if the grain had been kiln dried, and it will keep longer sweet than flour not kiln dried. I set all my machines in motion by the common means of cog and round tooth and pinion straps, ropes or chains well known to every mill wright.

" *Arrangement and connection* of the several machines so as to apply my principles to produce my improvements complete.

" I fix a spout through the wall of the mill for the grain to be emptied into from the wagoner's bag to run into a box hung at the end of a scale beam to weigh a waggon load at a draught. From this box it descends into the grain elevator, which raises it to a granary over the cleaning machines, and as it passes through them it may be directed into the same elevator to ascend to be cleaned a second time, and then descend into a granary over the hopper of the mill stones to supply them regularly, and as ground it falls from the several pair of mill stones into the conveyors where it is dried by the heated air of the kiln dryer, and is conveyed into the meal elevator to be raised and dropped on the cooling floor, within reach of the hopper boy, which receives and spreads it over the whole erea of the circle which it describes, stirring and turning it continually and gathering it into the boulting hopper which it attends regularly. That part of the flour which is not sufficiently boulted by the first operation, is conveyed by a conveyor or drill and let run into the eye of the mill stone to be ground over.

" Thus the whole of the operation which used to be performed by manual labour, is from the time the wheat is emptied from the wagoner's bag, or from the ship's measure until it enters the boults and the manufacture is completed in the most perfect manner, performed by the machinery and moved by the power which moves the mill, and this machinery keeps the meal in constant motion during the whole process of drying and cooling it more completely, avoiding all danger from fermentation, and preventing insects from depositing their eggs, and performing all the operations of grinding and boulting to much greater perfection, making the greatest possible quantity of the best quality of flour out of the grain, saving much time, and labour, and expense to the miller, and preventing much from being wasted by the motion of the machine being so slow as to cause none of the flour to arise in form of dust, and to be carried away by the air, and the cases of the machine being made close prevents any from being lost.

## THE ACADEMY OF THE FINE ARTS.

FOR the following article we are indebted to the Port Folio.

*The Pennsylvania Academy of Fine Arts* is situate on the north side of Chesnut, midway between Tenth and Eleventh-streets. The lot of ground is one hundred and seventy-eight feet deep; it recedes from the front line of the street seventy-five feet, has twenty-five feet vacant ground on each side, and forty-three feet back: it is set sufficiently high to admit of a terrace in front.

The present building, which is fifty feet front by sixty feet deep, is so calculated as to be a whole when finished; and, at the same time to admit of many future additions, viz. one room of one hundred feet by forty-three exterior at the back, and one on each side of fifty feet by twenty-five feet exterior: towards which additions the whole of the fire places, funnels, doors, and stair ways are already effected; and it is only necessary to break away four inches of brick work, where they will be found placed in a uniform and regular manner. The character of the exterior architecture is modern Ionick. The front elevation consists of a marble basement, four feet high, with (as is intended) a large flight of steps, to a recessed porch eighteen feet front on the front line, and ten feet deep; the remainder of the elevation consists of a high principal story and an attick, with cornice, parapet, frize, and neck moulding. The recessed porch is to have a column on each side, coupled (one diameter distant) with a pilaster against each side of the recess; a full order of entablature is to rest on the whole of these with trophies or plain tablets above; and the pavement is to be of marble slabs variegated, a centre for which has been presented by Mr. S. Gratz, of a quality equal to the Kilkenny, viz. of a fine jet black with an occasional sprinkling of pure white. The roof is nearly flat in every part, except where the dome appears, which is unique; it is a hemisphere of brick turned, two thirds of which was sprung without a centre, and the remainder, owing to the lateness of the season, with very slight and little centering. The whole could have been effected in a superiour stile had not the building been begun too late in the season; and it is a better mode than with centering, because every course of bricks keys itself, and is extremely simple; a single strip regulates the whole. Centering always costs more than the arching, hence it is economical, and can always be done in a circular arch, but not in a lineal one; on this arch immediately, and without any medium of wood, is laid a most complete piece of slate work, each piece of which is secured immediately to the first brick dome, and having stood the test of two winters may be pronounced a sound job. In addition, in consequence of having no rafters or any other work, except as before expressed, this roof costs less than a shingled one.

The interiour consists of a principal room, two committee rooms, three chambers, and complete pillars under the whole. The principal room is forty-six feet in diameter, and eighteen feet high to the springing of the ceiling, which is a dome having the sole light from its centre: the ceiling is plain, except a radius of light in stucco around the opening and semicircular architraves with reversed mouldings at the springing. The sides consist of eight tall pedestals alternating with an equal number of recesses, which open to stair ways or intended additional rooms; these recesses also consist of principal and attick pannels or openings; over these are arches whose saffits obtrude into the dome, the effect of which is novel; so that the dome appears (as it really does) to rest on those heightened pedestals, which have their full order of entablature occasionally relieved by guiloche enrichments. The whole of the building was completed from the commencement in eleven solid weeks (in all not seventeen weeks) and is a specimen of sound work."

To the same publication we are further indebted for the following

*Catalogue of Statutes and Busts in the Pennsylvania Academy of the Fine Arts.**

1. The *Pythian Apollo*, or *Apollo Belvidere*. This statute is much celebrated in sculpture, and esteemed by

* This article is said, by the editor of the Port Folio, to be from the pen of a lady, " who, after consulting the best authorities, has arranged her ideas and descriptions with all that grace, which feminine genius is so prone to display on every topick that awakens the imagination.

the majority of artists, the most excellent and sublime of all the ancient productions. It was found towards the end of the fifteenth century, at Capo d'Auzo, upon the sea coast, about twelve leagues from Rome, in the ruins of Antium. It was purchased during the cardinalate of pope Julius II, and placed in his palace near the church of Santi Apostoli; but soon after his elevation to the popedom, he removed it to the Belvidere of the Vatican, whence it derives its name, and where it was for three hundred years the admiration of the world; until Rome was taken and sacked by the French, who have transported this divine statue to the Museum at Paris.

The marble of which this statue was formed is of so peculiar a kind, as to occasion much doubt among antiquarians and naturalists, about the quarry it was taken from. The sculptors of Rome are of opinion that the marble is Grecian. It most probably, however, came from a quarry now entirely unknown. We can with as little accuracy denote the artist; although some accounts state, that this statue was the work of Agathias, the Ephesian, yet the *sçavans*, who were sent to Rome, at the time of the incursion of the French into Italy, to explore the works of art and their history, state, that the sculptor is certainly unknown. The god is here represented with his quiver hanging behind his right shoulder, and his pallium over his left arm, which is extended, and has in the hand the remains of a bow, from which he is supposed to have just discharged an arrow at the serpent Python. On this account the statue is called *Apollo Pythus* or Pythian Apollo. The stump of the tree, which appears to be introduced merely to support the figure, presents an interesting allusion, it being the trunk of the ancient olive tree of Delos, under whose shade the god was born, and the serpent, which surrounds it, is the symbol of physick, of which he was patron. The right fore arm, and the left hand, which were wanting, have been restored by *Giovanni da Montorsoli*, the pupil of Michael Angelo.

2. The group of *Laocoon*, the son of Priam and a priest of Apollo, who strongly opposed the admission of the wooden horse into Troy, which he knew enclosed the Greeks armed for the destruction of that city. To open the eyes of his fellow citizens, he even dared to direct his javelin against the fatal machine. Irritated by his temerity, the gods, who were enemies to Troy, decreed his punishment. Accordingly, when

on the sea-coast, Laocoon crowned with laurel, and attended by his two sons, was sacrificing to Neptune, two enormous serpents rushed suddenly upon them from the water. In vain he struggles, they encircle him and his children in their folds, and tear them with their venomous fangs. In spite of the efforts that he makes to disengage himself, this unfortunate father with his two sons, the deplorable victim of unjust vengeance, seeming, by their eyes turned towards heaven to implore mercy from the gods, expire in the most inexpressible agonies. Such is the subject of this admirable group, one of the most perfect works which the chisel has produced. A chef d'œure of composition, design and sentiment, which has stood the test of ages, and of which no commentaries have been able to weaken the impression. It was found in 1506, during the pontificate of Julius II, at Rome, on Mount Esquiline, in the ruins of the palace of Titus. Pliny, who speaks of it with admiration, saw it in the same place. To him we are indebted for the names of its sculptors, *Agesander*, *Polydorus*, and *Athenodorus*, of Rhodes. Agesander was probably the father of the others. They flourished in the first age of the vulgar era. The group is composed of five blocks, so artfully united that Pliny thought they were but one. The right arm of the father and the two arms of the children are wanting. They are not in the antique, though, doubtless they will one day be executed in marble as they have been restored by *Girardon* in plaster, to the original in the Louvre. All the copies have been made from the original without the addition of the arms. The only objection which has been made to the perfection of this group, is that the sons, with the countenance and expression of manhood, have only the size of children.

3. The *Venus de Medici* is here represented as just from the sea. Her divinely graceful form is unembarrassed by drapery, her hair collected behind, displays the beauties of her polished neck, and her head gently inclines to the left, as smiling affably upon the graces who are supposed to be about to attire her. The value of this statue is greatly heightened by its perfect preservation. It was found in Rome, about the middle of the last century, between the Quirinal and Viminal Mounts. It was placed in the garden of the Palace de Medici, from which it takes its name, to distinguish it from its rival sister, the Venus of the Capitol. It is

unnecessary to add that this statue is the admiration of the world. It was transplanted into Paris at the same time with Apollo, and this cast was made from the original, now at the museum there.

4. *Gladiator Borghese*, or fighting Gladiator. This has been improperly denominated of the Borghese palace. From the characters of its inscription it appears to be of greater antiquity than any other characterized by the name of the artist. History gives us no particular relative to *Agasias* of Ephesus, author of this chief d'œuvre ; but the work which he has left bears the strongest testimony of his merit. Antiquarians are divided in their judgment of this figure ; some have supposed it a Discobolus, or thrower of the disk ; but others with more probability, have pronounced it a statue, erected to the honour of some Grecian warriour, who had signalized himself on some perilous occasion. This appears perfectly to coincide with the attitude of the figure, which is at the same time actively offensive and defensive ; on the left arm the strap of the buckler, which he is supposed to carry is distinctly seen ; the right arm is supposed to hold a javelin ; his looks are directed upwards, as if defending himself from a danger, threatening from above. This position militates against the idea of its being the statue of a fighting gladiator, as his opponent may be supposed on horseback ; besides, it is believed the honour of a statue was never granted to a gladiator of the publick arena ; and this production is supposed anteriour to the institution of gladiators in Greece. It is, however, probable that it may have originated in the fancy of some ancient artist, who intended the attitude to correspond with the expression of the countenance and the amazing muscular strength of the figure. This statue, as well as the Apollo, was discovered in the city of Antium, the birth place of the emperour Nero, which he embellished at an enormous expense.

5. *The Venus of the Bath*, called *Venus Accroupie*, is supposed to be in the bath or just leaving it. It is not necessary that we should say much to recommend this beautiful little figure to those, who can appreciate excellence, and it is rare to see a subject, which has more charms. It is probably the work of *Polycharmus* who is known to have made a crouching Venus which was seen at Rome in the time of Pliny.

6. *Castor and Pollux*, by some supposed to be the Decii devoting themselves for their country. Nothing

can be learned with respect to this group, as to when, or by whom executed, or the supposed situation of the figures, which are so highly estimable for the symmetry of the form, and the delicacy of the execution. They were twin brothers, and sons of Jupiter and Leda. Mercury, immediately after their birth, carried them to Pallena, where they were educated, and as soon as they are arrived at the years of maturity, they embarked with Jason, on the Argonautick expedition. In this adventure both behaved with signal courage. The latter conquered and slew Amycus, in the combat of the cestus, and was after considered the god and patron of boxing and wrestling. The former distinguished himself in the * management of horses. After their return from Colchis they freed the Hellespont and the neighbouring pass from pirates, from which circumstance they have always been deemed the protectors of seamen. They were invited to the nuptial feast of Lycas and Idas, where becoming enamoured with the brides (the daughters of Leucippus) a battle ensued, in which Lycas fell by the hand of Castor, who was killed by Idas. Pollux revenged the death of his brother in the blood of Idas. Pollux, tenderly attached to his brother, and inconsolable for his loss, entreated Jupiter either to restore Castor to life, or permit him to resign his own immortality; Jupiter listened benignly to his prayer, and consented that the immortality of Pollux should be shared with his brother, and that it should be alternately enjoyed by them. This act of fraternal love Jupiter rewarded by making the two brothers constellations in heaven, under the name of Gemini.

7. *Germanicus*, son of Drusus and Antonia, is supposed to be represented by this statue. The style of the hair indeed indicates a Roman personage, but it cannot be this prince, for medals, and other monuments, represent him very differently. A more attentive examination of this figure discovers an analogy with that of Mercury; the extended position of the right arm, the chalmys, thrown over the left, which holds the caduceus, and rests on a tortoise, consecrated to this god as the inventor of the lyre, favor this idea. But a more reasonable conjecture might be admitted, that under these forms and with the attributes of the god of eloquénce, the ingeni-

* Debellator equorum.

ous artist has portrayed a Roman Orator celebrated for his powers on the rostrum. This beautiful statue in Parian marble is the work of Cleomenes the Athenian, and is not more valuable for the superiour excellence and symmetry of the form, than for its present preservation. It is taken from the gallery of Versailles, where it was placed in the reign of Louis XIV. It may also be seen at Rome in the Villa Montalto or Negroni.

8. *Ceres.* The original of this charming figure is of Parian marble: the correctness of its form, and delicacy of its drapery, entitle it to be called a model of taste. It is clad in a tunick, over which is thrown a mantle or peplum; both are finished in so masterly a manner, that through the mantle are perceived the knots of the cord, which ties the tunick round her waist. It was taken from the musuem of the Vatican, having been placed here by Clement XIV. It previously ornamented the Villa Mattei on Mount Esquiline, and was then incomplete. The artist, who repaired this statue, having placed in its hand some ears of wheat, the name of Ceres has probably from that circumstance been given to it: otherwise the virginal character of the head, and simplicity of its head dress, would induce a belief that the muse Clio was intended by it, and that a book should have been placed in the hand instead of the ears of wheat.

9. *Silenus*, with the infant Bacchus, or the reposing faun to the description of which this statue seems to answer, except that the figure is described as holding a flute in its right hand. The grace, which reigns in the figure, and the numerous copies of the original, which seems more properly executed in bronze, than in marble, would lead us to conjecture that this might be an antique copy of the *Faun* or *Satyr* of *Praxitiles*, worked in bronze, of which the reputation was so great in Greece that they distinguished it for its excellence by the name of περιβοετος, or the famous. This statue in Pentelican marble (so called from its quarry in Mount Pentelus near to Athens) was found in 1701, near to Lanuvium, now called Civita Lavinia, where Marcus Aurelius had a pleasure house. Benedict XIV. had it placed in the Museum of the Capitol.

10. *Antinous of the Capitol.* This young and amiable Bythynian, to whom the gratitude of the emperour Adrian raised such numerous monuments, we find here represented as scarcely having attained maturity. He

is naked; his position leaning, and the style of the hair, are somewhat similar to Mercury, whose wand probably he held in his right hand. In spite of the youthfulness expressed in this statue, we see imprinted in the expression of the face, and in the head, inclined towards the earth, that settled melancholy sadness by which we distinguish his portraits, and which has made this line of Virgil on Marcellus, applicable to him.

Sed frons læta parum, et dejecto lumina vultu.

The fore arm and left leg are modern. This beautiful statue in marble de Luni, comes from the Museum of the Capitol, where it was placed after having been in the collection of the Cardinal *Alexander Albani.*

11. *Fragment of a statue of Hercules*, called the *Torse of the Belvidere.* The remains of this admirable statue, although deprived by time of the head, the arms and the legs, appear to represent the son of Jupiter and Alcmena, at the moment when he becomes immortal on Mount Oeta. The lion's skin thrown on the rock where the figure is sitting, and the amazing size of the limbs leave no doubt of the true subject of this statue.

The sculptor has delineated no veins in the body of the hero, which is wonderful, as he is not represented in his youth, and his great muscular strength appears to exclude that plumpness of form, which alone could require the suppression of the veins. *Winkelmann* is of opinion, that the artist, by this, wishes to indicate the Apotheosis of Hercules, who is just about to change into a God on the funeral pile of Mount Oeta.

When we examine with attention, this incomparable fragment, we see many indications that the figure of Alcides was in a group with another figure placed on its left. The fable of the Apotheosis of Hercules recalls to us Hebe, the goddess of youth, that the new god had just obtained for his wife. A modern sculptor, M. Flaxman, an Englishman, has attempted to restore, in this sense, the copy of the Torse, and his essay has been crowned with the most complete success. This piece of sculpture, in Pentelican marble, presents on the rock, the following inscription (in Greek) "The work of Apollonius the son of Nestor, an Athenian." The account which we have is probably correct, that this precious fragment was dug up at Rome, towards the close of the fifteenth century, near the theatre of Pompey, now the *Campo di Toire.* It appears very probable, that it was in the time of Pompey this Athenian artist flourished in

Rome. Julius 2d placed this Torse in the garden of the Vatican, as well as the Apollo and the Laocoon. It served there for ages as a study for the Michael Angelos, Raphaels, and the Carracchis, to which we are indebted for the perfection of the Fine Arts. Artists have always known it under the vulgar name of the Torse of the Belvidere. There exists nothing of ancient sculpture executed in grander style.

12. *Apolline*, or, the *Young Apollo*. This statue is naked, and is supposed to hold his lyre in his left hand. This beautiful little figure, in Parian marble, is done in fine style.

13. *The Torso*, or, the *Trunk of Cupid*, called the *Grecian Cupid*. This beautiful figure is known by the name of the Grecian Cupid, who was sometimes, as in this instance, represented under the maturer age of adolescence, and possessed a character much more mild and reasonable than that attributed to the son of Mars and Venus. The supposition that this statue was intended for a Cupid is, perhaps, drawn from the evident marks of its having been originally with wings, one of the attributes of his divinity; but however the intention of the artist may be mistaken as to the subject, it will remain a monument of his excellence in his art. This beautiful fragment in Parian marble is taken from the museum of the Vatican, and was found at Centocelle, on the route from Rome to Palestrina, the same place where the fine statue of Adonis was found, which is now in the Louvre. It is likely, that this figure and many other copies of it which carry the quiver and the bow, were executed after the celebrated Cupid of *Praxitiles* which was to be seen at Parium.

14. *The first set of muscles in the human subject*, by the artist Houdon. A full length statue intended for students which is so highly esteemed, and seems so well calculated for the purposes of the Academy, that it has been introduced from a conviction of its usefulness. As auxiliary to young designers, the feet and hands of the *Farnese Hercules*, two casts of mouths and noses from the antique, and two ears by a modern artist, are also here.

15. A small copy of the *Farnese Hercules*, which is said to be admirably executed.

16. A small copy in marble of the *Venus de Medici*, and

17. A small copy in marble of *Antinous of the Capitol*, both presented to the Pennsylvania Academy of the Fine Arts, by Henry Wycoff, Esq. of Philadelphia.

Among the busts distinguished for the elegance of the workmanship, or the interest of the characters, are the following:

1. The *Mask of Jupiter*. Among the antique monuments which present us the image of this chief of gods and men, there is none more grand or pleasing than this. The serenity, the sweetness, and the majesty, which reign in all the features of this sublime head, give a perfect idea of the attributes which the ancients give to Jupiter. This head, in *marble de Luni*, is taken from the Museum of the Vatican, where Pius VI placed it. It was found in the ruins of the *Colonia Ocriculana*, now called Otricoli, about seventeen leagues from Rome on the Flaminian road. It probably belonged to a colossal statue.

2. *Homer*. This fine bust represents the immortal Homer, the father of Grecian poetry, and to whom seven cities disputed the honour of having given birth. The bandeau, or diadem which encircles his head, is the emblem of the divinity which his exalted genius merited, and which obtained him the honour of his apotheosis. The formation of the eyes, of admirable execution, indicates blindness, a misfortune under which this poet is generally supposed to have laboured. This bust in Pentelican marble, is taken from the museum of the Capitol. It was first discovered by the antiquary *Ficoroni*, who accidentally met with it in the place of a common stone in the wall of the palace *Caetani*, he bought it and gave it to the Cardinal Alexander *Albani*, who sold it afterwards to Clement XII. Although the portrait of Homer has always been considered doubtful, even among the ancients, it is yet well known that busts, similar to this, have passed under his name.

3. *Diana, of Versailles*. The superb statue from which this bust is taken, is in Parian marble, and we are informed of its being in France during the reign of Henry IV. It was without doubt the most perfect of all the *antiques*, which were to be found there, before the conquest of Italy enriched France with so many *chef d'œuvres*.

4. The *Head of Rome*, of which the entire statue is now at Rome in Parian marble. This bust is taken from the gallery of the Chateau de Richelieu.

5. A *Faun* suspended from a tree, probably a personification of the river Tiber.

6. *Minerva.* This bust is antique, and being in the same style of a very elegant statue in Pentelican marble, which was known in the ducal palace of Modena, it is supposed to have been taken from it.

7. *Venus of Arles.* This bust is taken from a statue found at *Arles*, in 1651, and which makes one of the principal ornaments of the gallery at Versailles. It is in Greek marble, and this bust was worked by *Mellan* in 1669.

8. *Euripides.* This bust presents to us the features of one of the most celebrated tragick poets of Greece. The correctness of this portrait is proved by its entire resemblance to another bust which is at Rome, and on which the name of Euripides is engraven in Greek. It is executed in Pentelican marble, and taken from the academy at Mantua.

9. *Cicero.* This bust, executed in Pentelican marble, is taken from the museum of the capitol at Rome.

10. *Hippocrates*, the father of medicine, was born at Cos, about 460 years before the vulgar era, and is here represented in his most advantageous age. The correctness of this portrait, as well as those which are at Rome and Florence, is known by its resemblance to one which is preserved on a medal, struck at Cos, his birth-place, and which was found in the cabinet of *Fulvius Ursinus.*

11. *Demosthenes.* The statue from which this bust is taken was formerly at the villa *Montalto*, now *Negroni*, on mount Esquiline, whence Pius VI transported it to the Vatican. This head is antique.

12. *Socrates.* Proofs of the correctness of this likeness may be found in the fifth volume of the description of the museum of *Pio Clementino.*

13. *Seneca.* This bust is taken from a fine statue in the Borghese Palace.

14. *Diogenes.*

15. *Lucius Junius Brutus*, taken from a bust in bronze at the capitol in Rome.

16. *Ulysses.*

17. *Alexander the Great.*

18. *Alexander Severus.*

19. *Vespasian.*

20. *Nero*, the last of the Cesars of the race of Augustus. The portrait of this monster is not flattered in this bust, which delineates the unrelenting frown of a negro

driver, and the insolent air of an unprincipled ruffian in power. This is copied from the bronze which was moulded from the original in the 16th century.

21. *Titus.*

22. *Caracalla.* The ferocious look and the turn of the head towards the left side, make this portrait in Pentelican marble, an exact resemblance of the celebrated *Farnesian* bust of this cruel emperour.

23. *Vitellius*, is taken from the hall of antiques in the Louvre.

24. *Sappho.*

26. *Group of Niobe.* Among the busts which ornament the museum, this group, with the head of Niobe, ought to engage particular attention, from the acknowledged purity of style that reigns throughout the heads which compose it. The Abbe Winkelmann, a most classical judge of the arts, has pronounced the head of Niobe to be a model of the highest style of beauty; and *Guido*, the *painter of the Graces*, made it his peculiar study. The age of their execution is supposed to be that of the highest glory of the arts, that is, in the time of *Phidias;* but it is not ascertained whether the statues, which now compose this interesting group at Florence, are the originals or not. By the jealousy and hatred of Latona, the children of Niobe fell victims to the darts of Apollo and Diana, and the expression of Niobe is strongly indicative of peculiar distress.

## PHILADELPHIA MUSEUM.

FROM THE PORT FOLIO.

This museum is the property of Charles W. Peale, who began it in 1785, with some bones of the Mammoth, and the Paddle-fish, which were then added to his picture gallery: shortly after, relinquishing his profession as a portrait painter, his exertions were directed, and have been ever since devoted to the present establishment. His persevering industry has been so far crowned with success—and when the plans now preparing for execution shall be accomplished, the institution, in point of arrangement, preservation, and number, will rival in value and utility any of a similar nature.

In 1802 the legislature of Pennsylvania, influenced by an idea of its increasing utility, granted for the use of the museum, the greater part of the State-house, where it is now displayed in a manner better becoming the importance of the institution, and more worthy of the state which gave it birth.

—————— " Here, undisturbed,
By noisy folly, and discordant vice,
On nature muse with us and nature's God." MILTON.

*Quadruped Room.* This room which is 40 feet long, contains upwards of 190 quadrupeds, mounted in their natural attitudes—those of the larger kinds, with their names in gilt frames, are placed on pedestals behind wire netting; the smaller quadrupeds are in glass cases on the opposite sides of the room; numerical catalogues in frames over each case, state the genera to which they belong, and their specifick names in Latin, English, and French. The Linnæan classification is generally adopted throughout the animal department.

Among the most remarkable of the quadrupeds are the long clawed Grisly Bear from the source of the Missouri; the American Buffaloe or Bison; the Great Ant Eater (seven feet seven inches from the snout to the tip of the tail); the Ourang Outang, or Wild Man of the Woods; the Crested Porcupine, some of whose quills measure 18 inches; the American and New Holland ditto; Madagascar Bats, measuring 4 feet from tip to tip; the Hooded Bat, &c. The Lama or Camel of South America; the untameable Hyæna, and fierce Jackall; American Elks; the Picary, remarkable for a secretory organ on its back; the slow moving Bradypus or Sloth; Antelopes from Africa; the Indian Musk of astonishing agility; and the Kangaroo, or Opossum from Botany Bay, &c. Various horns of different animals.

And a large electrical machine sufficiently powerful to give a moderate shock, without the Leyden phial.

*Long Room.* Linnæus's classification of birds, with the characters of each order and genus, is, for want of space to display it better, exhibited in a gilt frame at the entrance of the Long Room. All the birds are in glass cases, the insides of which are painted to represent appropriate scenery; mountains, plains, or waters, the birds being placed on branches or artificial rocks, &c. These cases, rising 12 feet from the floor, extend the whole length of this room, which is 100 feet, producing an uncommonly elegant display.

The first order, rapacious birds, begins in the upper row at the head of the room, and extends nearly to the centre; each succeeding order beginning at the left, and extending to the right. In frames over each case, the genus is first noted, then their species, and names in Latin, English, and French, referring to the numbers which are attached to each species.

There are now in this collection (including many nondescripts) perhaps all the birds belonging to the middle, many of which likewise belong to the northern or southern states; and a considerable number from South America, Europe, Africa, Asia, New Holland, and the new discovered islands in the South seas. The variety of interesting objects in this department is too great particularly to enumerate a few; the number exceeds 760, without the admission of any duplicates contained in 140 cases.

On projecting cases, between the windows at the west end of the room, is a classification of 4000 insects in gilt frames. Those species which are too small to be examined with the naked eye are placed in microscopick wheels with the numbers continued from the glass frames; there are also two other compound microscopes of a new construction, adapted to a large collection of choice insects, one for opaque and the other for transparent objects, with a catalogue of each.

Projecting between the windows at the east end of the room, are glass cases containing minerals and fossils, arranged according to Kirwan. Among the clays are some American specimens, equal to those of which the finest porcelain is made, in China, or France; various fine coloured earths, proper for pigments; a variety of handsome chrystals and precious stones, among which the North American Topaz. Among the calcareous specimens in case 1, are, a petrifick incrustation of a bird's nest and eggs; a petrified fish from the top of a mountain near Naples; an elegant concretion of small cornu-ammonis. It is of importance that this department should, and, it is hoped, ere long will contain a more complete collection of American minerals, accompanied with a description of the quantity, and situation where found.

In case 2. Vesuvian Lavas, polished; curious stones: Amber enclosing perfect Insects; Sulphurs, Bitumens, Native Gold, Silver, and other ores—among which the splendour of the iron is most conspicuous.

Case 3, contains a valuable collection of Fossil Shells from Hampshire, England; a variety of Petrifactions and Incrustations—among them the great American Oyster, Clam, and Pediculus Marinus found with the Mammoth; Shrimp, Crabs, Fishes, Ferns, &c. and an elegant polished segment of a Cornu-Ammonis, showing the cellular structure.

Case 4, contains miscellaneous articles—among which are a lock of silvery hair of the beautiful Nictalops of England; various Calculi, Coins, &c. and five jars showing the result of Dr. Hunter's analysis of City Pump Water, viz. 220 gallons of water evaporated yielded 24 oz. common salt, 32 oz. Salt Petre, 17 oz. Magnesia, and 12 oz. Lime!

Over the birds, in handsome gilt frames, are two rows of Portraits of distinguished personages, painted from the life, by C. W. Peale and his son Rembrandt. This collection was begun in 1779, and contains various other characters of distinction beside civil and military; such as Franklin, Priestly, Rittenhouse, Sir Joseph Humboldt, &c.—Their names are in frames over each portrait, yet there is a number which refers to a concise account of each person in small frames on the opposite cases. Of seventy persons here pourtrayed, forty are dead—Some portaits of a larger size adorn each end of the room. One of J. Hutton of Philadelphia, who died aged 108 years and four months.

In a gallery in the centre, between the windows, is an excellent organ for the use of such visiters as are acquainted with musick.

A person attends in this room with Hawkins' ingenious Physiognotrace, for the purpose of drawing profiles.*

*Marine Room.* In the centre of the room, supported on a pedestal, stands the Chama, a shell three feet long, and 185 pounds weight; a pair of them are behind the railings.

A railing at each end of the room encloses the larger Fishes and amphibious Animals, on each of which in a gilt frame, is the respective name, viz. Sharks, Lizards, Sword, and Saw-fishes, Sun-fish remarkable for having neither flesh nor bones, being wholly cartilaginous, and equally extraordinary for its bulk and form more resembling the head of an immense fish than an

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* The attendant is allowed to receive 8 cents for cutting out each set of profiles, from such as choose to employ him.

entire one. The smaller Fishes, Lizards, Tortoises, Snakes, Snakes with two heads, &c. are displayed in two large glass cases, on inclined shelves, with numbers referring to a framed catalogue. The tops of the cases are ornamented with artificial rock work, supporting marine productions, such as corals, sea fans, feathers, &c.

Between the windows, projecting six feet into the room, are four glass cases, containing a classical arrangement of shells, corals, sponges, &c.

Against the wall are sundry skins of large snakes; one 16 feet long (Amboiya) from South America, and the beaks of sea fishes.

*Arts and Antiquity.* This part of the Museum is in the Philosophical Hall.*

*Mammoth Room.* Contains the skeleton of the Mammoth which was discovered in Ulster county (New York) in 1801. It is the first put together, and is as valuable as it is stupendous—being an almost perfect skeleton, the bones belonging to one animal, and very few deficient. It is 11 feet 10 inches high, and 19 feet long. A particular account, by Rembrandt Peale,† of its discovery, with many interesting remarks on it, is in 92 gilt frames, hung up in a convenient gallery for viewing the skeleton.

The Mammoth is a nondescript, and as it is called, Antedeluvian animal, with carnivorous grinders; and although formerly supposed to be a species of elephant, yet differing from it, and from all other animals in several extraordinary particulars. Since the year 1740 the learned have been gratified with the occasional discovery of various mutilated collections of similar bones; but it was not until 1801, that C. W. Peale, after great exertions, was enabled to obtain this skeleton. Some bones of the Mammoth first gave rise to the Museum in 1785, which, sixteen years after, possessed the first entire skeleton.

Here is also part of the skull of an animal of the ox kind, the pith of the horn measuring 21 inches in circumference—probably the horns would have measured

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* To prevent mistakes, all donations intended for the Philadelphia Musuem should be directed to C. W. Peale, with such memorandums as are interesting, and the name of the donor.

† Pamphlets of this may be had at the Museum.

from 14 to 16 feet from tip to tip.—This precious relick belongs to the the Philosophical Society, by request of the donor, Dr. Brown, to be placed with the Mammoth.

There are in the same room, various small skeletons, such as the monkey, greyhound, parrot, ibis, ground hog, &c. and that of an ordinary mouse, as an object of contrast with the Mammoth.

In frames hung up against the wall, are engravings of the whole skeleton, and detached parts of an unknown quadruped of the Sloth kind, of great size, found in South America, and now in the Museum at Madrid. Inside the railing are similar bones found in Virginia. Encircling the door are the lower jaw-bones of a whale 13 1-2 feet long.

*Model Room.* Extending across this room, in front of the windows, is a case containing 1400 elegant casts from antique gems which are a part of the collection in the Antique Room ; a silver salt seller, which belonged to Oliver Cromwell, presented by Mrs. Washington ; antique pot, household gods, and bas reliefs, from the cities of Herculaneum and Pompei : curiously fabricated earthen pots found in South America—(in case 3 is a pot resembling these, found in Tennessee, 25 feet deep ;) Chinese instruments and ornaments, and a considerable variety of such as are used by the Aborigines of North and South America, such as wrought tubes of stone, chrystal hatchets, &c.

Around the room are displayed some paintings, and a number of Indian curiosities, models of canoes, spears, bows and arrows, clubs, paddles, baskets, the Phoonka or great Chinese fan, Chinese match gun, and ancient bow gun, &c.

Here is the beginning of a collection of models of useful, foreign, and domestick machinery—such as the Chinese plough and wheel-barrow ; Cottle's thrashing machine ; a dry dock ; improved spinning wheel, &c. On the floor stands a throne of curious workmanship, said to be executed by the king of the Pelew Islands, out of a solid piece.

In cases 2 and 3, are models in wax, the size of life, of the following characters, drest in their real and peculiar habiliments, viz.—Chinese labourer and gentleman ; inhabitant of Oonalaska ; Kamskadale ; an African ; a Sandwich Islander ; an Otaheitan ; a South American ; and Blue Jacket and Red-pole ; celebrated sachems of North America. These cases likewise contain a great variety of articles of Indian dress and ornaments of extraordinary workmanship.

*Antique Room.* Contains several fine casts from the celebrated statues of antiquity, deservedly the admiration of the world, such as the Apollo de Belvidere, the fighting and dying Gladiators, the Antinous, Meleager, Venus of the Capitol, Venus Calliope, the crouching Venus, Paris, together with Hudson's Diana, besides 12 busts, and 10 basso relievos. We are indebted for these casts to the taste and liberality of Mr. Smith, the brother of William Loughton Smith, Esq. of South Carolina, who deposits them with Mr. Peale until they form part of an American academy of the fine arts.

P. S. As this museum, like all others, has necessarily grown into importance by means of a gradual increase from the collection and careful preservation of individual subjects; the same means pursued with unceasing care will ensure its greater perfection. The proprietor therefore solicits the assistance of gentlemen travelling into foreign countries, into whose hands articles occasionally fall, which are rendered valuable in a collective view, but otherwise lost to the publick, and of little value to the possessors.

## PATENT IRON BOUND BOOTS, BOOTEES, AND SHOES.

These are manufactured by Mr. John Bedford of Philadelphia, and appear to be preferable in many respects to those which are made in the ordinary method. The patentee in his advertisement informs the publick, that "shoemakers by his improvement are able to make four times the quantity of shoes that can be made in the common way with the same number of hands; for example, the usual work of three men, is only three pair of common shoes per day; whereas in the improved way, three men with the assistance of a boy, can make from twelve to fifteen pair per day. Thus the advantages, resulting from the improvement are evidently of the most essential importance. In the first place three fourths of the labour is saved; in the second place half the leather is saved, for one pair of shoes made in this way will wear as long as two pair made in the usual way; and in the third place, there is a saving of flax, at the rate of one pound to twenty pair of shoes, they are also much more water proof than the others, and easier mended.

" These are well ascertained facts, proved by actual experience. The patentee therefore hopes, that an improvement fraught with such important publick utility, will not only engage the attention, but the encouragement of every friend to the infant manufactures of this country. It may not be amiss to remark, that the country shoemaker in particular, may derive incalculable advantages from this improvement, as he can supply his customers in one fourth of the time he has usually devoted to that purpose, and have the other three fourths for the cultivation of his farm or other avocations.

" Price of patent rights, for the country, one hundred dollars ; for states, districts, or towns, in proportion.

The Editor has purchased a pair of boots made according to Mr. Bedford's patent, which he has reason to believe (not having had them long in possession) will fully justify him in corroborating the statement of Mr. Bedford relative to the advantages resulting from this improvement.

*The Pneumatick Cock*, is a simple, ingenious, and useful contrivance for tapping air-tight casks, which obviates the necessity of a vent peg. The inventor, Mr. Robert Hare, jun. in giving a description of this invention observes, " it is well known that an air-tight cask is usually tapped by means of two apertures, one in the upper part for the admission of air, the other below for the emission of the fluid ; or in other words, by means of a vent peg and cock. This method would not be very objectionable, were the vent peg always firmly replaced as soon as the admission of air becomes no longer necessary ; but this is seldom attended to, and the consequence is the frequent sourness or vapidity of vinous liquors. The quantity of liquor thus annually spoiled by this omission of vent-pegs, must be immense ; and must be particularly great in those families where tapsters are too numerous to be responsible for neglect.

To obviate these evils, Mr. Hare has contrived a cock with two perforations which are opened or shut by turning the same key, the air entering at the upper perforation the fluid passing out at the lower, with a velocity proportioned to the depth of the emitting orifice below that which admits the air into the cask. The fixed air however, which is generated in casks containing vinous liquors will sometimes more than counteract the pressure of the atmosphere, and thus dispose the liquor to issue through every aperture. In this case while the cock is open it will be necessary to close the upper orifice with the thumb, while the fingers are holding the key.

The cock must be of a bended form so that the key may be situated below the orifice which receives the liquor, and the nozle should taper downwards in order to give a sufficient velocity to the fluid from the cask.*

### HYDROSTATICK BLOW-PIPE.

This is an invention of the same gentleman whose ingenious contrivance was the subject of the last article, and will prove of great use to the artist.

It consists of a cask in length thirty-two inches, and its least diameter eighteen inches. It is divided by a partition into two apartments; the upper and external apartment is in depth fourteen inches; the lower and internal apartment is in depth sixteen inches, and contains a sheet and pipe of copper which descend into it nine inches, forming two equal compartments of that depth. The sheet and pipe of copper are soldered together and inserted into the partition. The edges of the sheet were slid down into corresponding joints in the staves of the cask until the partition obtained its proper situation. Cooper's flags were then passed into the joints, and the hoops were driven on the cask.

In the lower apartment of the cask is placed a pair of bellows, the bottom of the cask serving for the bottom of the bellows. In the centre of this bottom there is a hole, round which, at the distance of one inch from its centre is a circular rim of wood. On this is nailed a valve opening upwards. The top of the bellows is a circular piece of wood seven inches in diameter and two in thickness. In its centre there is a hole one inch and a half in diameter. Around this hole is a circular orbit, in which is nailed a valve opening upwards. In this top, at the distance of one inch from its perimeter, is a circular dovetailed furrow filled with lead. The body of the bellows is composed of strong hose leather, so as to be water tight. Before it was fixed to the other parts of the bellows its form was that of a hollow frustrum of a cone, of which the perpendicular and greatest diameter

* For a more particular account of this invention we would refer our readers to Transactions of the American Philosophical Society, vol. vi. part i. p. 105.

were each eight inches, and whose least diameter was six inches and a half. It was more easily fastened to its appendages when of this conical form than when cylindrical. It was kept distended by two iron rings to which it was sewed fast.

This bellows is worked by an iron rod which passes from its top through the copper pipe and the top of the cask, and may be worked by a handle or lever over a perpendicular piece or standard of timber, or by foot, by means of a stirrup appended to the handle.

This bellows is so contrived by the ingenious inventor that by distending it by means of the rod and lever, it is supplied with air or gas, by the vacuum thus made, which is gradually again discharged by directing a small hose and blow-pipe to a lamp or candle, the blaze of which may be directed to the subject of operation; and substances may thus be fused which have been hitherto deemed infusible. Perhaps, however, it would be impossible to obtain an adequate idea of this invention without consulting the original paper and the drawings accompanying it, as first published by order of the Chymical Society, Philadelphia, and afterwards republished in the fourteenth volume of Mr. Tilloch's magazine, London, and likewise in the Annales de Chimie tome 45.

We learn, likewise, by a paper from the same author, subsequently published in the Transactions of the American Philosophical Society, that by the aid of this apparatus strontites may be fused, and platina volatilized. We must, however, refer those who would enter minutely into the subject, to the papers alluded to in the two last articles.

*Improvement in printing*. In the art of printing, an important improvement invented by Mr. Hugh Maxwell, has been made and in practical use in three printing offices of Philadelphia. The improvement consists of a roller used for inking the type. The advantages of which are greater regularity in the distribution of the ink, a perfect equality of colour, with a trifling attention, a considerable saving in the expense of printing, and a cleanliness, as respects picks, monks, and friars, not to be attained by the utmost care with the common balls. Another advantage which will be felt by every printer who adopts this plan, the accident of drawing letters so destructive to printing type, so injurious to part of the machinery of the press, and frequently productive of gross errours, is totally avoided.

The machine is light and pleasant work for a boy of ten or twelve years of age, and proves on actual trial a saving on each press to which it is constantly used of about six dollars per week, and the quantity of work performed on one press is more than what can be done in the usual way. One of those machines has been in constant operation for seven months, and during that period has not required one hour's attention. There is no preparation necessary, but cleaning, which is performed in a few minutes. The trouble of preparing new balls, and knocking up balls, which on the old plan consumes so much time is in this machine totally saved. It is computed, that in saving of time one fifth more can be done per day than on the old plan, with all the superiorities enumerated.

Two of those machines are now in constant use in the printing office of Smith and Maxwell, one in the office of Benjamin Johnson, and one in the office of Thomas S. Manning, where they may be seen at work.

The machine is furnished complete for one hundred dollars.

*A carpet manufactory*, has lately been established in Philadelphia, by John Dorsey, Esq. in which carpeting is manufactured of a quality not inferiour to the best imported.

## MANUFACTURES IN DELAWARE.

In Wilmington there are, according to Dr. Morse, a cotton manufactory, and a boulting cloth manufactory. In the county of Newcastle are several fulling mills, two snuff mills, one slitting mill, four paper mills, and sixty for grinding grain, all of which are turned by water. " But though Wilmington and its neighbourhood are probably already the greatest seat of manufacture in the United States, yet they are capable of being much improved in that respect, as the country is hilly and abounds with running water. The Brandywine might, with a moderate expense, when compared with the object, be brought to the top of the hill on which Wilmington is situated, whereby a fall sufficient for forty mills, in addition to those already built would be obtained." On the Brandywine are twelve merchant mills which contain double that number of pairs of mill stones of large dimensions and superiour construction. A saw mill completes the group, and they may all be seen at one view. It is thought that the mills on the Brandywine are capable of manufacturing 400,000 bushels in a year. These mills employ about 200 persons, including the coopers, who manufacture the casks, and others employed in operations connected with the mills. The navigation to these mills is such, that a vessel carrying 1000 bushels of wheat may be laid along side of any of them. Vessels containing 1000 bushels of wheat frequently come up with the flood tide, unlade and go away with the succeeding ebb with 300 barrels of flour on board. In consequence of machines introduced by Mr. Oliver Evans, the specification of whose patent for such machines we have published in the preceding pages three fourths of the manual labour necessary before his inventions is saved in the manufacturing of flour in these mills.

## MANUFACTURES, &c. OF MARYLAND.

Mines of iron of an excellent quality have been found in many parts of this state. Furnaces for making pigs and hollow ware of this ore are erected in various parts of the state. Mines of coal, similar to the Virginia coal have been discovered and opened within a mile of Baltimore. In Frederick county, according to Dr. Morse, are eighty grist mills, two glass works, two iron works, two furnaces; between two and four hundred stills, and two paper mills.

In no part of the United States has there been more spirit displayed and greater exertions made for establishing useful manufactories than in Baltimore. A company has lately been established for that purpose, who it is said are bound to invest no less than half a million of dollars in promoting and establishing the manufactures of Maryland. They have already begun to erect manufactories for spinning of cotton, and have other kinds of new manufactories in contemplation.

An aqueduct has lately been made for supplying the city with water. In this it is intended that a fall of a part of the water conducted in this aqueduct shall raise by appropriate machinery another part to supply those parts of the town which are above the head of the aqueduct, while the water which falls will be conducted onward for the supply of the lower part of the town.

## AGRICULTURE, MANUFACTURES, CANALS, &C. OF VIRGINIA.

In the year 1785, the legislatures of Virginia and Maryland passed acts to encourage the opening of the navigation of the Potomack river by means of locks at the falls which impeded it. A company had likewise been incorporated in Virginia for the purpose of extending the navigation of James river from the tide water to the mountains. In the first of these corporations, general Washington was presented by the legislature of Virginia with fifty shares of 100l. sterling each, and in the latter with one hundred shares of 100 dollars each. These donations were accepted by General Washington on conditions expressed in his will, that these shares should be appropriated as follows: The fifty shares in the Potomack company " towards the endowment of a university, to be established within the limits of the district of Columbia, under the auspices of the general government, if that government should be inclined to extend its fostering hand towards it; and until such seminary is established, and the funds arising on these shares shall be required for its support, my further will and desire is, that the profit accruing therefrom, shall, whenever the dividends are made be laid out in purchasing stock in the bank of Columbia, or some other bank at the discretion of my executors, or by the treasurer of the United States for the time being, under the direction of congress, provided that honourable body should patronize the measure; and the dividends proceeding from the purchase of such stock are to be vested in more stock, and so on, until a sum adequate to the accomplishment of the object is obtained, of which I have not the smallest doubt before many years pass away, even if no aid or encouragement is given by legislative authority, or from any other source."

The shares which General Washington held in the James river company were, by another clause in the same will, given and confirmed in perpetuity to the use and benefit of Liberty Hall Academy, in the county of Rockbridge, in the commonwealth of Virginia.

Virginia possesses many valuable mines. A lump of gold ore has been found near the falls of Rappahannock river, which yielded 17 dwt. of gold. In the county of Buckingham, between James and Appomatox rivers have been found small lumps of fine gold from the size of a pin's head to the size of a hazlenut, to the value of several hundred dollars.

On the great Kenhawa opposite to the mouth of Cripple creek, and also about twenty-five miles from the southern boundary of the state, in the county of Montgomery are mines of lead. The metal is mixed sometimes with earth and sometimes with rock, which requires the force of gunpowder to open it; and is accompanied with a portion of silver, too small to be worth separation under any process hitherto attempted there. The proportion yielded is from 50 to 80lb. of pure metal from 100lb. washed ore. The most common is that of 60 lb. The veins are at sometimes very flattering, at others they disappear suddenly and totally. They enter the side of the hill and proceed horizontally. Two of them have been wrought by the publick. These would employ about fifty labourers to advantage. Thirty men, who have at the same time raised their own corn, have produced sixty tons of lead in the year; but the general quantity is from twenty to twenty-five tons. The present furnace is a mile from the bank and on the opposite side of the river. The ore is first wagoned to the river, a quarter of a mile, then laden on board canoes, and carried across the river, which is here about two hundred yards wide, and then taken into wagons and carried to the furnace. This mode was originally adopted that they might avail themselves of a good situation on the creek for a pounding mill; but it would be easy to have the furnace and the pounding mill on the same side of the river, which would yield water without any dam, by a canal of about half a mile in length. From the furnace the lead is transported one hundred and thirty miles along a good road, leading though the Peaks of Otter to Lynch's ferry, or Winston's on James river, from whence it is carried by water about the same distance to Westham. This land carriage may be greatly shortened, by delivering the lead on James river, about the Blue Ridge, from whence a ton weight has been brought in two canoes. The Great Kenhawa has considerable falls in the neighbourhood of the mines. About seven miles below are three falls of three or four feet perpendicular each; and three miles above is a rapid of three miles continuance, which has been compared in its descent by many to the great fall on James river. Yet it is the opinion, that they may be laid open for useful navigation, so as to reduce very much the portage between the Kenhawa and James river.*

Iron mines are frequent in this state, which afford iron of remarkable toughness. Copper mines have been opened, but did not succeed.

The country on each side of James river from fifteen to twenty miles above Richmond abounds in coal mines, which have been worked to an extent equal to the demand. The coal of Pittsburg is of a very superiour quality. Some have conjectured from appearances that the whole tract between the Laurel Mountain, Missisippi and Ohio yields coal. A bed of coal at Pittsburgh has been on fire for many years.

Marble of a fine quality and in great abundance has been found on James river, at the mouth of Rockfish. It forms a precipice and hangs over a navigable part of the river.

*Mineral springs in Virginia.* These are numerous and highly celebrated for their efficacy in a variety of disorders.

The acidulous water, commonly called the Sweet Spring, is situated between two small mountains in the county of Bath. This spring is plentifully supplied with water, and a small distance from its source assumes the appearance of a small river. This water is whitish and clear, has an acidulous taste, and sulphureous after it is drunk. Its temperature is warm agreeing with that of the atmosphere in summer. They contain, in a quart,

| | GRS. |
|---|---|
| Saline substances in general - | 12 to 15 |
| Earthy substance - - - | 18 to 24 |
| Iron - - - - - - - | 1 to 1 1-2 |

These waters are recommended in chronical disorders. In debility remaining after fevers acute or intermittents; disorders having vitiated humours, a viscosity of the lymph, *king's evil*, simple or complicated, swelling of the viscera without schirrosity, as swelling of the liver, spleen, pancreas, mesenterick glands, and preternatural heat of the body.

* Morse.

*Red Spring.* This spring rises out of a rock of the argilloso calcareous kind, and spreads from the mountain in which it originates down a valley which produces acidulous waters in every part. This water, when drunk at the spring, has a very light, acidulous, chalybeate taste, mixed with something putrid. It contains in the quart

| | Grs. |
|---|---|
| Aerial acid - - - - | 0 |
| Calcareous earth or lime - - | 4 |
| Aerated magnesia - - - | 3 |
| Iron aerated - - - - | 2 |
| Selenites - - - - - | 1 |
| Vitriol of magnesia - - - | 1 |
| Cabic muriatic salt - - - | $\frac{1}{2}$ |
| Iron combined - - - - | 1 |

These waters are gently stimulant, tonick, and antiseptick. In weak stomachs and bowels they are mild purgatives, and when the tone is restored become astringents. If there is any *acrimony* or *sourness* of the *prima viæ*, they relax.

*Hepatick or Sulphureous water.* The spring from whence this water flows is situated in Green Briar county on the west side of the Allegany, and rises out of a kind of freestone, mixed with mica. The hills in the vicinity bear evident marks of having been partially *torrefied* by subterranean fires. It contains

| | Grs. |
|---|---|
| Of hepatick air - - - - | 0 |
| Aerial acid - - - - - | 0 |
| Calcareous earth - - - - | 12 |
| Vitriol of magnesia - - - | 5 |
| Selenites - - - - - | 2 |
| Calcareous marine salt - - | $1\frac{1}{2}$ |
| Iron, more or less - - - | 2 |
| Sulphur precipitated - - - | $\frac{1}{4}$ |

These waters are useful in cutaneous diseases, such as the itch, pimples of all kinds, red spots, whether scorbutick or not, fistulas, cracks of the skin, where the disease is merely topical.

*Red Sulphur Spring.* "This is in Munro County, about forty miles from the sweet spring. It receives its name from the circumstance of the appearance of the sediment which the water deposits, and which is nearly the colour of poke berries.

"The taste of the water indicates sulphur, but not in so great quantity as the sulphur spring before mentioned. This spring, which has not long been discovered, is growing into great repute, both in pulmonary complaints, and in eruptions of various kinds."

"*Berkley Springs*. Are in the town of Bath and county of Berkley, on the river Potomack, in a fertile country; and have within a few years been much frequented by invalids. The water is a little warmer than common water and very soft. The waters prove diuretick if the person walks about after drinking them. But if he remain quiet they will purge gently and copiously. They have no particular taste: they have rendered much benefit to persons labouring under jaundice or affections of the liver.*

A new mineral spring has been discovered in Virginia, near Harrisburg, on the land of Mr. Taylor. Its temperature is warmer than that of the springs in the neighbourhood. It is thought to be impregnated with carbonick acid gas, but we do not know that its waters have been ever accurately analyzed.

There are several other mineral springs in this state of considerable celebrity, and we would refer the reader, who would wish for a more particular account of the virtues and the ingredients which give them their salubrious qualities, to Dr. Rouelle's Treatise on the Mineral Waters of Virginia, and to the Geological Account of the United States, by Dr. Mease.

## AGRICULTURE, AND MANUFACTURES &C. OF KENTUCKY.

Of the manufactures of Kentucky we possess but little information. A large cotton manufactory has been in contemplation but we have not been able to learn whether it has been established. A vineyard is begun likewise, under the superintendence of a Swiss gentleman, and in 1803 consisted of 10 acres. Here are paper mills, oil mills, fulling mills, and many valuable grist mills.

The soil is reported to be astonishingly fertile. Lands of the first quality are too rich to produce wheat; but will produce 50, 60, and in some instances even a hundred bushels of Indian corn to an acre. A species

* Dr. Mease.

of rye, according to Imlay, was found growing wild in this state and on the flats near the Ohio. It had a bearded ear, like the cultivated rye, the beard being somewhat longer and the ear less.

Caves, according to the same author, have been discovered in this country of several miles in length, under a fine limestone rock, supported by curious arches and pillars. Sulphureous springs are common. One is near a salt spring in the neighbourhood of Boonsborough. There are three springs or ponds of bitumen near Green river, which do not form a stream but empty themselves into a common reservoir, and when used in lamps, answer all the purposes of the best oil. Copperas and alum are among the minerals of Kentucky. Near Lexington are found curious sepulchres full of human skeletons. It has been asserted that a man in or near Lexington, having dug five or six feet below the surface of the ground, came to a large flat stone, under which was a well of common depth artificially stoned. At the bottom of the falls in the Ohio, is a small rocky island, overflown at high water, which is remarkable for its petrifactions. Wood, roots, and fish bones are found petrified; also a hornet's nest, a bird, and several fishes.

## MANUFACTURES, AGRICULTURE, AND ANTIQUITIES OF THE STATE OF OHIO.

Ship building is carried on to a very great extent in this state. In the spring of 1803 the schooner "Indiana" of 100 tons, the brig "Marietta" of 130 tons, and another of 150 tons were built in this state. Good judges of naval architecture have pronounced these vessels equal in point of workmanship and materials to the best that have been built in America. The firmness and great length of their planks, and the excellency of their timbers (their frames being wholly composed of a wood which, if properly selected, has nearly the strength of white oak, and the durability of the live oak of the south without its weight) it is believed will give these vessels the preference over any built of the timber commonly made use of, in any market where there are competent judges.

"This part of the country owes much to those gentlemen, who, in a new and experimental line, have set this example of enterprise and perseverance; an example which has had its effect, for several more vessels are on the stocks; and which has succeeded thus far beyond the most sanguine expectations. Indeed we may confidently look forward to a time when a great proportion of the shipping used in the United States will be built on the western waters. The materials for this purpose are very abundant and excellent.

"Of the timber, and that of the best kind, such as black walnut, white oak, and locust, there are inexhaustible quantities.

"The immense height of the forests, enables the workmen to get timber and plank of any length they wish, and no part of the union can furnish better masts and spars than are here made of the yellow pine. No country can produce the article hemp in greater abundance or at a more moderate price. Even in this early stage of agriculture in this new region, its price has not commonly exceeded one hundred dollars a ton. Already have two rope-walks been set up on an extensive scale in the town of Marietta; and a manufactory of sail cloth is proposed. A few years since bar iron cost at the rate of three hundred dollars a ton; but such advances have been made in the manufacture as to supply all the demand at less than half that price. It will soon be as cheap as it is afforded in any part of the United States. Tar in plenty is brought down the Alleghany and sold here at a reasonable rate. The abundance of coal *(lithanthrax)* for the supply of the forges and the workshops of artizans, and its vicinity to the town, to which it may be brought by water carriage; together with the cheapness of provisions are additional circumstances in favour of this undertaking. Besides, difficulties apprehended in floating vessels of burthen to the ocean experiment has proved not to exist. The height of the freshets, in the spring, which commonly rise from thirty to forty feet perpendicular altitude, affords a sufficiency of water for large ships, if the owners will have the precaution to be ready in season to take advantage of it, and so uniform and unbroken is the current, that no risk is found in navigating it.

"*Curiosities.* In the bank of the Ohio river, about one hundred and thirty miles above its junction with the Mississippi, is a large cave called by the Indians, "*the habitation of the Great Spirit.*" The following description of it was taken on the spot by a gentleman of observation. "For about three or four miles before you come to this place, you are presented with a scene truly romantick. On the Indiana side of the river you see large ponderous rocks piled one upon another, of different colours, shape, and sizes. Some appear to have gone through the hands of the most skilful artist; some represent the ruins of ancient edificcs; others thrown promiscuously in and out of the river, as if nature intended to show us with what ease she could handle those mountains of solid rock. You see again purling streams winding their course down their rugged front; whose appearance in a moonlight night, added to the murmuring noise they occasion, is truly beautiful, though it rather disposes the mind to solemnity: while others project so far that they seem almost disposed to leave their doubtful situation. After a small relief from this scene, you come to a second, which is something similar to the first; and here, with strict scrutiny you discover the cave. Before its mouth stands a delightful grove of cypress trees, arranged immediately on the bank of the river. They have a fine appearance, and add much to the place. The mouth of the cave is but a few feet above the ordinary level of the river, and is formed by a semicircular arch of about eighty feet at its base and twenty-five feet in height, the top projecting considerably over, forming a regular concave. From the entrance to the extremity, which is about one hundred and eighty feet, it has a regular and gradual ascent. On either side is a solid bench of rock; the arch coming to a point about the middle of the cave, where you discover an opening sufficiently large to receive the body of a man, through which comes a small stream of a very clear and well-tasted water, which is made use of by those who visit this place. From this hole a second cave is discovered, whose dimensions, form, &c. are not known. The rock is of limestone. The sides of the cave are filled with inscriptions, names of persons, dates, &c."*

## AGRICULTURE, MANUFACTURES, &C. OF NORTH CAROLINA.

The pitch pine of North Carolina is said by Dr. Morse to be much superiour to that of the northern states. It affords pitch, tar, turpentine, and lumber. This pine, he informs us, is of two kinds, the common and the long leaved. The latter has a leaf shaped like other pines, but is nearly half a yard in length, hanging in large clusters. It furnishes the best of white and red

* Harris's Tour.

oak timber. The swamps are fertile in cypress and bay trees. This part of the country abounds in medicinal plants, such as ginseng, snake-root, and an herb like ipecacuanha; (lion's heart) which is a remedy for the bite of a serpent.

In the river Yadkin, a little to the southward of Salisbury, shad are caught in immense quantities in consequence of their being compelled to pass through a narrow rapid.

There are in this state a number of furnaces and forges which furnish iron, reported to be of a very fine quality.

A gold mine has been discovered in Cabarrus county which has furnished the mint of the United States with a very considerable quantity of virgin gold.

We learn from the report of the director of the mint, that 11,000 dollars gold coin had been furnished to the mint of the United States, from this mine previous to the year 1805.

## AGRICULTURE, MANUFACTURES, &C. OF TENNESSEE.

Of these the editor has no information which might justify him in making this a long article. Mr. Fisk who is quoted by Dr. Morse informs us, that

" The piercing northerly winds that prevail during the winter in the Atlantick states, seldom molest the inhabitants on Cumberland river; for they have no great mountains to the northward or westward. The inhabitants of the Atlantick states are also subject to sudden changes in the atmosphere, arising from their vicinity to the ocean. The air that comes from the surface of the sea, especially from the warm gulf stream in winter, must be very different in its temperature from the air that comes across the cold and high mountains; but the great distance between the Cumberland settlers and the ocean, considering that many great mountains intervene, effectually secures them against the bad effects of those sudden changes. North easterly storms never reach this country.*

" Other circumstances present themselves, by which we may account for the remarkable healthiness of this

* In the " History of Vermont" by Dr. Williams may be found much information on this subject.

country. Limestone is common on both sides of Cumberland mountain. There are no stagnant waters; and this is certainly one of the reasons why the inhabitants are not affected with those bilious and intermittent fevers which are so frequent, and often fatal, near the same latitude on the coast of the southern states. Whether it proceeds from the goodness of the water, the purity of the air, the temperature of the climate, or whatever may have been the cause, the inhabitants are certainly remarkably healthy ever since they settled on the waters of Cumberland river." GOVERNOUR BLOUNT.

## AGRICULTURE MANUFACTURES, &c. OF SOUTH CAROLINA.

The soil of this part of the United States is divided into the pine barren, valuable for its timber. Savannas, which are good for grazing. Swamps, containing a mixture of loam and clay. In these rice is cultivated, which constitutes the staple commodity of the state. And the highlands, which are covered with oak and hickory. It is supposed that olives, silk and madder may likewise be produced in this state as well as in Georgia.

At the distance of about 110 miles from the sea, the river swamps terminate, and the high lands extend quite to the rivers, and form banks in some places, several hundred feet high from the surface of the water, and afford many extensive and delightful views. These high banks are interwoven with layers of leaves and different coloured earth, and abound with quarries of freestone, pebbles, flint chrystals, iron ore in abundance, silver, lead, sulphur, and coarse diamonds.

The swamps about the head of the tide, are occasionally planted with corn, cotton, and indigo. The soil is very rich, yielding from forty to fifty bushels of corn an acre.*

This country abounds with precious ores, such as gold, silver, lead, black lead, copper and iron; but it is the misfortune of those who direct their pursuits in search of them, that they are deficient in the knowledge of chymistry, and too frequently make use of improper menstruums in extracting the respective metals. There are

* Morse.

likewise to be found pellucid stones of different hues, rock chrystal, pyrites, petrified substances, coarse cornelian, marble beautifully variegated, vitreous stone and vitreous sand; red and yellow ochres, which, when roasted and ground down with linseed oil, make a very excellent paint; also potter's clay of a most delicate texture, fuller's earth, and a number of die stuffs, among which is a singular weed which yields four different colours its leaves are surprisingly styptick, strongly resembling the taste of alum; likewise an abundance of chalk, crude alum, sulphur, nitre, vitriol, and along the banks of rivers large quantities of marle may be collected.

"There are also a variety of roots, the medicinal effects of which it is the barbarous policy of those who are in the secret to keep a profound mystery. The rattle snake root, so famous amongst the Indians for the cure of poison, is of the number. The next is the venereal root, which under a vegetable regimen, will cure a confirmed lues. Another root, when reduced to an impalpable powder, is singularly efficacious in destroying worms in children. There is likewise a root, an ointment of which with a poultice of the same, will in a short space of time discuss the most extraordinary tumours. particularly what is termed the white swelling; this root is very scarce. There is another root, a decoction of which in new milk, will cure the bloody dysentery; the patient must avoid cold, and much judgment is requisite in the potion to be administered. There is also a plant, the leaves of which being bruised and applied to the part affected, relieves rheumatick pains; it occasions a considerable agitation of the parts, attended with most violent and acute pains, but never fails to procure immediate ease. There is also a plant, the leaves of which have a most fetid smell. These leaves being boiled, any person afflicted with cutaneous complaints, once bathing therein will be radically cured. There is a root which acts as an excellent purge, and is well calculated for the labouring part of mankind, as it is necessary only to chew it in its crude state, and it requires no manner of aid to facilitate its operation. An equally efficacious and simple purge is obtained from a weed, the stalk of which is red, is about three feet high, and the flower white; the leaves run from the bottom of the stalk in opposite and corresponding lines; the seed is about the size of a wheat grain, globular in the centre, and oblate at both ends; it is full of oil, and tastes like a walnut kernel; 20 grains of this chewed and swallowed are, in point of mildness and efficacy, equal to any rhubarb: and the pleasantness of its taste, as a deception to weak stomachs, appears to have been a design of Providence. In its operation it resembles castor oil. A very sovereign remedy is extracted from the bark of a tree, which may be used to great advantage in the diseases incident to this climate. Every climate some believe has its peculiar disease, and every disease its peculiar antidote under the same climate. In addition to the above is another species of bark of a sweet and nauseous taste; the tree grows contiguous to a very powerful chalybeate spring; the bark when sufficiently masticated, operates as a very potent purge and emetick, and in the hands of a skilful chymist may be rendered very serviceable. M. BARRETT.

## AGRICULTURE, MANUFACTURES, MINERAL SPRINGS, &c. OF GEORGIA.

In the county of Wilkes, within a mile and a half of the town of Washington, is a medicinal spring which rises from a hallow tree, four or five feet in length. The inside of the tree is covered with a coat of matter, an inch thick, and the leaves around the spring are incrusted with a substance as white as snow. It is said to be a sovereign remedy for the scurvy, scrofulous disorders, consumptions, gouts, and every other disease arising from humours in the blood.

Cobb's mineral springs are situated in the county of Jefferson, and are famed for their medicinal virtues. In the summer they are a place of resort. Thirty or forty houses, or cabins of logs, are built for the accommodation of visitants.

One of the greatest curiosities in this state is the bank of oyster shells in the vicinity of Augusta, ninety miles from the sea, already described, page 192. On the banks of Little river, in the upper part of the state, are several curious and stupendous monuments of the power and industry of the ancient inhabitants of this country. Here are also traces of a large Indian town.

The chief articles of export are rice, cotton, tobacco, (of which the county of Wilkes only exported in 1788, about 3,000 hogsheads) indigo, sago, lumber of various kinds, naval stores, leather, deer skins, snake root, myrtle and bees wax, corn and live stock. The planters and farmers raise large stocks of cattle, from 1,000 to 1,500 head, and some more.

The value, in sterling money, of the exports of Georgia, in the year 1755, was 15,744 *l.*—in 1772, 121,677 *l.* sterling money. In the year 1791, 491,250 dollars—in 1795, 695.985 dollars—in 1801, 1,755,939 dollars—in 1804, 2,077,572 dollars.

In 1755, 9 square rigged vessels, and 43 sloops, together making 1,899 tons, cleared out of Georgia, and in 1772, 84 square rigged vessels, and 133 sloops, whose tonnage was 11,246.

In return for the enumerated exports are imported West India goods, teas, wines, various articles of clothing, and dry goods of all kinds. From the northern states, cheese, fish, potatoes, apples, cider and shoes. The imports and exports of this state are principally to and from Savannah, which has a fine harbour, and is a place where the principal commercial business of the state is transacted. The trade with the Indians in furs and skins was very considerable before the war, but has since been interrupted by the wars in which they have been involved. The manufactures of this state have hitherto been very inconsiderable, if we except indigo, silk and sago.

The manner in which the indigo is cultivated and manufactured is as follows: The ground, which must be a strong rich soil, is thrown into beds of 7 or 8 feet wide, after having been made very mellow, and is then raked till it is fully pulverized. The seed is then sown in April, in rows at such a distance as conveniently to admit of hoeing between them. In July the first crop is fit to cut, being commonly two and a half feet high. It is then thrown into vats, constructed for the purpose, and steeped about thirty hours; after which the liquor is drawn off into other vats, where it is beat, as they call it, by which means it is thrown into much such a state of agitation as cream is by churning. After this process, limewater is put into the liquor, which causes the particles of indigo to settle at the bottom. The liquor is then drawn off, and the sediment, which is the indigo, is taken out and spread on cloths, and partly dried; it is then put into boxes and pressed, and while it is yet soft, cut into square pieces, which are thrown into the sun to dry, and then put up in casks for the market. They have commonly three cuttings a season. A middle crop for 30 acres, is 1,300 pounds, The culture of silk and the manufacture of sago are at present but little attended. The people in the lower part of this state manufacture none of their own clothing for themselves or their negroes. For almost every article of their wearing apparel, as well as for their husbandry tools, they depend on their merchants, who import them from Great Britain and the northern states. In the upper parts of the country, however, the inhabitants manufacture the chief part of their clothing from cotton, hemp, and flax.*

AGRICULTURE, MANUFACTURES, &C. OF THE MISSISSIPPI TERRITORY.

" Although this country might produce all the valuable articles raised in other parts of the globe, situated in the same latitudes, yet the inhabitants principally cultivate indigo, rice, tobacco, Indian corn, and some wheat; and they raise large stocks of black cattle, horses, mules, hogs, sheep, and poultry. The sheep are said to be the sweetest mutton in the world. The black cattle, when fat enough for sale, which they commonly are the year round, are driven across the country to New Orleans, where there is always a good market.

This country is principally timbered with all the different kinds of oak, but mostly with live oak of the largest and best quality, uncommonly large cypress, black walnut, hickory, white ash, cherry, plum, poplar trees and grape vines. Here is found also a great variety of shrubs and medicinal roots. The lands bordering the rivers and lakes are generally well wooded; but at a small distance from them are very extensive natural meadows, or savannas, of the most luxuriant soil, composed of a black mould about one foot and a half deep, very loose and rich, occasioned in part, by the frequent burning of the savannas; below the black mould is a stiff clay of different colours. It is said, this clay, after being exposed some time to the sun, becomes so hard that it is difficult either to break or bend, but when wet by a slight shower of rain, it slackens in the same manner as lime does when exposed to moisture, and becomes loose and moulders away; after which it is found excellent for vegetation.

* Morse.

This country being situated between the latitudes of 30° and 31° north, the climate is of course very mild and temperate; white frosts and sometimes thin ice, have been experienced here; but snow is very uncommon."

" The soil of this country is superiour to any of the lands on the borders of the river Mississippi, for the production of many articles. Its situation being higher affords a greater variety of soil, and is in a more favourable climate for the growth of wheat, rye, barley, oats, &c. than the country lower down, and nearer to the sea. The soil also produces, in equal abundance, Indian corn, rice, hemp, flax, indigo, cotton, pot-herbs, pulse of every kind, and pasturage; and the tobacco made here is esteemed preferable to any cultivated in other parts of America. Hops grow wild; all kinds of European fruit arrive to great perfection, and no part of the known world is more favourable for the raising of every kind of stock. The climate is healthy and temperate; the country delightful and well watered; and the prospect is beautiful and extensive, variegated by many inequalities and fine meadows, separated by innumerable copses, the trees of which are of different kinds, but mostly of walnut and oak. The rising grounds, which are clothed with grass and other herbs of the finest verdure, are properly disposed for the culture of vines; the mulberry trees are very numerous, and the winters sufficiently moderate for the breed of silk worms. Clay of different colours, fit for glass works and pottery, is found here in great abundance; and also a variety of stately timber fit for house and ship building, &c. The elevated, open and airy situation of this country renders it less liable to fevers and agues (the only disorders ever known in this neighbourhood) than some other parts bordering on the Mississippi, where the want of sufficient descent to convey the waters off occasions numbers of stagnant ponds, whose exhalations infect the air.

MANUFACTURES, &C. OF LOUISIANA.

" There are but few domestick manufactures. The Acadians manufacture a little cotton into quilts and cottonadas; and in the remote parts of the province, the poorer planters spin and weave some negro cloths of cotton and wool mixed. There is one machine for spinning cotton in the parish of Ibberville, and another in the Opelousas; but they do little or nothing. In the city, besides the trades which are absolutely necessary, there is a considerable manufacture of cordage, and some small ones of shot and hair powder. There are likewise in and within a few leagues of the town twelve distilleries for making taffia, which are said to distil annually a very considerable quantity; and one sugar refinery, said to make about 200,000 lb. of loaf sugar."

" *Navigation employed in the trade of the province.* In the year 1802, there entered the Missisippi 268 vessels of all descriptions, 18 of which were publick armed vessels, and the remainder merchantmen, as follows, viz.

| | American. | Spanish. | French. |
|---|---|---|---|
| Ships | 48 | 14 | |
| Brigs | 63 | 17 | 1 |
| Polacres | | 4 | |
| Schooners | 50 | 61 | |
| Sloops | 9 | 1 | |
| | 170 | 97 | 1 |

Of the number of American vessels, 23 ships, 25 brigs, 19 schooners, and 5 sloops came in ballast, the remainder were wholly, or in part laden. The Spanish ships and 7 schooners came in ballast. The united tonnage of all shipping that entered the river, exclusive of the publick armed vessels, was 33,725 register tons. In the same year there sailed from the Missisippi 265 sail, viz.

| | American | | Tons. | Spanish. | | Tons. |
|---|---|---|---|---|---|---|
| Ships | 40 | 1 in ballast | 8972 | 18 | | 3714 |
| Brigs | 58 | | 7526 | 22 | 1 in ballast | 1944 |
| Schooners | 51 | | 4346 | 58 | | 3747 |
| Sloops | 8 | | 519 | 3 | 1 in ballast | 108 |
| Polacres | - | | - | 3 | 1 in ballast | 240 |
| | 158 | | 21,383 | 104 | | 9753 |

| | French. | Tons. |
|---|---|---|
| Schooners | 3 | 105 |

| | Total. | Tons. |
|---|---|---|
| Americans | 158 | 21,383 |
| Spanish | 104 | 9753 |
| French | 3 | 105 |
| Grand total, | 265 | 31,241 |

The tonnage of the vessels which went away in ballast, and that of the publick armed ships, are not included in the foregoing account; these latter carried away masts, yards, spars, pitch, tar, &c. at least 1000 tons. In the first six months of the present year, there entered the Mississippi 173 sail, of all nations, 4 of which were publick armed vessels, viz. 2 French and 2 Spanish, whose tonnage is not enumerated.

| | American. | Tons. | Spanish. | Tons. | French. | Tons |
|---|---|---|---|---|---|---|
| Ships | 23 | 5396 | 14 | 3080 | 5 | 1002 |
| Brigs | 44 | 5701 | 20 | 2173 | 8 | 878 |
| Polacres | | | 3 | 480 | 2 | 436 |
| Schooners | 22 | 1899 | 18 | 1187 | 7 | 483 |
| Sloops | 4 | 278 | 3 | 167 | | |
| Total, | 93 | 13,264 | 58 | 7087 | 22 | 2804 |

| | Total of Ships. | Total of Tons. |
|---|---|---|
| American, | 93 | 13,264 |
| Spanish, | 58 | 7087 |
| French, | 22 | 2804 |
| Grand total, | 173 | 22,155 |

In the same six months there sailed from the Missisippi 156 vessels, viz.

| | American. | Spanish. | French. |
|---|---|---|---|
| Ships | 21 | 18 | 2 |
| Brigs | 28 | 3 | 1 |
| Polacres | | 4 | |
| Schooners | 17 | 26 | 5 |
| Sloops | 2 | 1 | |
| | 68 | 80 | 8 |

# APPENDIX.

## CORRECT LIST OF ALL THE PATENTS

THAT HAVE BEEN TAKEN OUT OF THE OFFICE OF THE SECRETARY OF STATE, FROM JULY, 1790, TO JANUARY 1805, SPECIFYING THE SUBJECT OF THE PATENTS, WITH THEIR DATES, AND THE NAMES OF THE PATENTEES.

1790.

MAKING pot and pearl ashes, Samuel Hopkins, July 31. Manufacturing candles, Joseph Stacey Sampson, Aug. 6. Manufacturing flour and meal, Oliver Evans, Dec. 18.

1791.

Punches for types, &c. &c. Francis Bailey, Jan. 29. Improvement in distilling, Aaron Putnam, Jan. 29. Driving piles for bridges, John Stone, March 10. Threshing grain and corn, machine for, Samuel Mulliken, March 11. Breaking and swingling hemp, &c. Samuel Mulliken, March 11. Machine for cutting and polishing marble, &c. Samuel Mulliken, March 11. Machine for raising a nap on cloths, &c, Samuel Mulliken, March 11. Machine for spinning flax, hemp, &c. George Parkinson, March 17. Improvement in tide mills, Jonathan Dickerson, July 30. Machine for making nails, Samuel Briggs, sen. and jun. Aug. 2. Machine for threshing wheat, &c. William Thomson, Aug. 2. Diminishing the friction of spindles, Robert R. Livingston, Aug. 4. Making the extracts of barks, John Biddis and Thomas Bedwell, Aug. 10. Improved bedstead, Ludwig Conrod Kuhn, Aug. 10. Manufacturing boots, Peter Gordon, Aug. 10. Propelling boats by cattle, Henry Voight, Aug. 10. Manufacturing gunpowder. Henry Keyser, Aug. 10. Horizontal water-wheels for Mills, James Macomb, Aug. 26. Improvement of Dr. Barker's mill, James Rumsay, Aug. 26. Improved mode of working mills, James Rumsey, Aug. 26.

Improvement of Savary's steam engine, James Rumsey, Aug. 26. Bellows, James Rumsey, Aug. 26. Generating steam, James Rumsy, Aug. 26. Propelling boats or vessels, James Rumsey, Aug. 26. Propelling boats, &c. by steam, &c. John Fitch, Aug. 26. Improved boiler of the steam engine, Nathan Read, Aug. 26. Improvement in distilling, Nathan Read Aug 26. Boiler for generating steam, John Stevens, jun. Aug 36. Improvement in captain Savary's steam engine, John Stevens, jun. Aug. 26. Application of steam to work bellows, John Stevens, jun. Aug. 26. Improvement of Savary's steam engine, Englehart Cruse, Aug 26. Machine for clearing docks or harbours, Peter Zacharie, Nov. 24. Machine for spinning cotton, William Pollard, Dec. 30.

1792.

Cleansing whale oil, Benjamin Folger, Jan 2. Spinning and twisting thread, Obadiah Herbert, Jan. 28. Steam Jack, John Bailey, Feb. 23. Hardening and tempering steel, David Hartley, Feb. 24. Improvement in making bricks, David Ridgeway, March 7. Canvass conductor to be used when houses are on fire, Samuel Green, March 28. Weaving of wire, Timothy Kirk and Robert Leslie, May 9. Machine for sawing wood and bark, Thomas Farrington, May 9. Preservation of plants from frost, &c. George Morris, July 10. Machine called "the wheel of knives," for shearing and raising the nap on cloths, Samuel G. Dorr, Oct. 20. Hand-mill for picking millstones, Solomon Hodge and Jonathan Dorr, Oct. 23.

1793.

Improved machine for manufacturing tobacco, James Caldwell and Christopher Batterman, Jan 26. Improvement in wind mills, Joseph Pope, Jan. 26. Manufacturing bricks, Christopher Colles, Jan. 26. Improved mode of turning a spit, Samuel Morey, Jan. 29. Double pendulum for ships, Robert Leslie, Jan. 30. Clock pendulum, Robert Leslie, Jan. 30. Double pendulum, Robert Leslie, Jan. 30. Manufacturing oiled silk and linen, &c. Ralph Hodgson, Feb. 1. Manufacturing rhus or sumach, Richard Rosewel Saltonstall, Feb. 28. Improvement in paper moulds, John Carnes, jun. April 11. Furnace for pot and pearl ashes, Edward Ryan, April 29. Moulds for claying sugar, Jonathan Williams, jun. March 13. Manufacturing rhus or sumach, Richard Rosewell Saltonstall, May 1. Stove of cast iron, Robert Heterick, June 11. Applying and regulating the sails of ships, boats, &c. Joseph Stacey Sampson, July 5. Manufacturing brick and pantile, Samuel Brouwer, Aug. 17. Machine for propelling vessels, &c. Abijah Babcock, Dec. 2. Disputed claim for a machine to work in a current of water, &c. decided in favour of John Clarke, Daniel Stansbury, Apollos Kinsley, John Clarke, Dec. 31.

1794.

Manufacturing nails, Thomas Perkins, Feb. 7. Weaving and beating sail duck, James Davenport, Feb. 24. Improvement in distilling spirituous liquors, Joseph Simpson, March 4. Round saw, Zachariah Cox, March 14. Machine for ginning cotton, Eli Whitney, March 14. Mode of preventing the progress of fire, Benjamin Taylor, March 23. Improvement in manufacturing paper, &c. John Biddis, March 31. Composition for flooring houses, &c. Richard Robotham, April 12. Improvement in carriages, to be propelled by the mechanical powers, John J. Staples, April 25. Machine for threshing grain, &c. William Hodgson, April 28. Construction of bellows, James Drake, May 19. Manufacturing of candles, Richard Robotham, June 2. Manufacturing cordage, George Parkinson, June 16. New mode of grinding bark, John Markley, July 19. Improvement in the method of working pumps, Elisha Rigg, July 29. Improvement in a steam still, Alexander Anderson, Sept. 2. New mode of propelling vessels, Benjamin Wynkoop, Sept. 13 Mode of making salt, James Fennel, Sept. 24. Improvement in making bricks, Apollos Kinsley, Feb. 1, 1793. Construction and tone of bells, Robert Leslie, Feb. 2, 1793. Improvement in Hydraulicks, Joshua Hatheway, Oct. 29. Improvement in a threshing machine, James Wardrop, Nov. 5. Improvement in stills, John Kincaid, Nov. 25. Tempering mortar and making bricks, Apollos Kinsley, Dec. 20.

1795.

Machine for cutting nails, Jacob Perkins, Jan. 16. Improvement in the mode of breaking hemp and flax, Samuel Mulliken, Jan. 15. Improvement in shearing woollen and other cloths, Samuel Kellogg, Jan. 31. Machine for cutting nails, Josiah G. Peerson, March 23. New mode of catching fish, Joseph Ellicott, March 25. Improvement in the application of steam, Samuel Morey, March 25. Construction of a caboose, John Youle, May 25. Improvement in the manufacturing of cordage, John Pitman, May 25. Improvement in propelling boats, Daniel Keller, May 25. Propelling boats, &c. with horses, William Peter Sprague, June 19. Nautical ventilators, Benjamin Wynkoop, June 19. Tinned sheet copper condensing worm, John Taylor, June 30.

1796.

Improvement in making nails, Jared Byington, Jan. 15. Improvement in sawing and polishing marble, &c. Jonathan Dickerson, Jan. 9. Manufacturing seal skins, James Eaton, Feb. 12. Removing pains, &c. by metallick points, Elisha Perkins, Feb. 19. Raising water by wind, Samuel Morey, April 11. Machine for cleaning wheat, &c. &c Benjamin Tyler, April 15. Improvement in tanning leather, James

Davis, April 14. Improved mode of forming a yellow colour, Thomas Bedwell, April 20. Composition of "bilious pills," Samuel Lee, jun. April 30. Machine for cutting nails and brads, Peter Zacharie, May 4. Improvement in manufacturing, sumach, Joseph Hilyard, May 12, Improvement in bolting cloths, Robert Dawson, May 12. Improvement in the cotton gin, Hodgen Holmes, May 12. Cleaning clover and other seeds, &c. Jonathan Roberts, jun. Feb. 13. Improvement in piano fortes, James Sylvanus M'Lean, May 27. Improvement in burr mill-stones, Oliver Evans, May 28. New invented steam engine and boiler, Elijah Backus, May 31. Stays for removing distortions in the spine, Lunden M'Kechnie, July 1. Improvement in Sawing and polishing marble, &c. Joseph Francis Mangin, July 2. Machine for scouring rice and other grain, Robert Grant, Oct. 17. Improvement in making salt, George James, Nov. 16. Improvement in concentrating the volatile parts of calcareous earth, stones, &c. John Fowler, Nov. 16. Improvement in manufacturing cut nails, Peter Cliff, Nov. 16. Machine for heading and cutting nails, Isaac Garretson, Nov. 16. Improvement in a printing press, Apollos Kinsley, Nov. 16. Improvement in splitting sheep skins, James Stansfield, Nov. 16. New method of ruling books and paper, Mark Isambard Brunel, Nov. 16. Improvement in pumps, Theobald Bourke, Nov. 16. Manufacturing potash, William Frobisher, Nov. 17. Improvement in forging bolts and round iron, Clement Rentgin, Nov. 17. Improvement in a loom for weaving cloth, Amos Whittemore, Nov. 17. A "preambulator" for measuring a ship's way, Amos Whittemore, Nov. 19. Machine for cutting nails, Amos Whittemore, Nov. 19. Improvement in manufacturing nails, John Bigelow, Nov. 19. Improvement in cutting and heading nails, &c. George Chandlee, Dec. 12. Conjuror for cooking and boiling, Thomas Passmore, Dec. 23. Improvement in manufacturing cut nails, Daniel French, Dec. 23. Improvement in manufacturing wrought nails, Daniel French, Dec. 23. Improvement in heading nails, Jared Byington, Dec. 23. Improvement in heading nails, Jason Frost, Dec. 23. Machine for separating scoured rice, James Dellet, Dec. 23. Improvement in ginning cotton, Robert Watkins, Dec. 23. Improvement in ginning cotton, John Murray, Dec. 23.

1797.

Improvement in making soap. John Nazro, Jan. 6. Extracting alkali from marine salt and kelp, John Nazro, Jan. 6. Improvement in bridges, Charles Wilson Peale, Jan. 21. Improvement in cutting and heading nails, James Spence, Feb. 16. Improvement in cutting and polishing marble, &c. Joseph F. Mangin, Feb. 16. Improvement in stoves, James M'Callmont, Feb. 20. Improvement in scouring or skinning rice, Samuel Mulliken, Feb. 20. Improvement in chimneys, Richard Stuart, Feb. 24. Improvement in bridges, John Fowler, Feb. 24. Improvement in cutting and heading nails, Jesse Kersey, Feb. 24. Improvement in mixing colours and painting, Lawrence Allwine, Feb. 24. Improvement in stoves, Thomas Hirst, March 11. Machine for threshing wheat, &c. William Booker, March 11. Improvement in a tide-water wheel, Silas Betts, March 18. Improvement in washing clothes, Nathaniel Briggs, March 18. Improvement in stoves, Caleb Wheaton, March 29. Improvement in fire engines, Jesse Kersey, April 13. Improvement in boring pumps, Caleb Leach, April 13. Combination of astringent woods and vegetables in distilling, &c. Fitch Hall, April 17. Improvement in propelling boats and vessels, by steam engines, Jehoshaphat Starr, April 28. Improvement in propelling carriages, William Faris, April 29. Antibilious pills, Benjamin Duval, May 3. Improvement in constructing and rigging vessels, Isaac Garretson, May 29. Improvement in bridges, John Stickney, June 3. Improvement in manufacturing wool cards, &c. Amos Whittemore. June 5. Improvement in looms, David Grieve, June 8. Raising a nap on cloths, Walter Burt, June 23. Rollers for slitting and other mills for rolling iron, Benjamin Seymour, June 26. Improvement in straitening iron hoops, Benjamin Seymour, June 26. Pendulous bellows, for pumping ships, Benjamin Wynkoop, June 26. Improvement in making candles, Joseph Stacey Sampson, June 26. Improvement in ploughs, Charles Newbold, June 26. Mode of preserving butter, Moses Johnson, June 30. Improvement in forming bricks, tiles, &c. John Hawkins, July 11. Improvement in extracting teeth, Thomas Bruff, July 1. Improvement in making shingles, boards, &c. Bill Jarvis, July 8. Improvement in cutting tobacco, Apollos Kinsley, August 12. Improvement in cutting and heading nails, Jonathan Nevil, August 12. Improvement in saw-mills, Henry Dulheur, August 18. Improvement in mills, Jonathan W. Curtis, August 24. Improvement in fire-places, Charles W. Peale, Nov. 16. Improvement in saddles, Thomas Stickney, Nov. 16. Improvement in breaking dough and paste, Daniel Pettibone, Nov. 16. Improvement in threshing grain, Richard R. Eliot, Nov. 16. Improvement in clocks, time-keepers, and watches, Eli Terry, Nov. 17. Improvement in making sashes, Stephen Parsons, Nov. 20. Machine for propelling boats, John Martin, Nov. 21. Improvement in bridges, Timothy Palmer, Dec 17. A spiral wheel for working in tide-water, Elias Ring, Dec. 10. A soap-stone stove, William Payne, Dec. 10. Improvement in making nails, Lester Fling, Dec. 19.

1798.

Machine for cutting and heading nails, Nathan Read, Jan. 8. Improvement in grinding coffee, Thomas Bruff, senior, Jan. 8. Machine for printing paper, leather, &c. John Dixey, Jan. 24. Improvement in cutting and pointing comb-teeth, Isaac Tryon, Feb. 22. Improvement in wind-mills, Charles Holden, March 15. Machine for dipping candles, Samuel Blydenburg, March 22. Steam saw-mill, Robert M'Kean, March 24. Mill for sawing boards, Aaron Clarke, March 30. Screw engine for throwing water, Elijah Ormsbee, March 21. Improvement in raising water from fountains, John Manning, April 10. Regulating the action of the tide on his spiral wheel, John Martin, April 27. Machine for raising water, Mark Isambard Brunel, April 27. Machine for removing rocks, &c. Isaac Lazell, May 18. A double steam engine, James Smallman and Nicholas J. Roosevelt, May 31. Machine for threshing wheat, &c. Thomas C. Martin, June 2. Machine for propelling vessels, Charles Stoudinger, June 2. Water-wheel flume for large streams, Walter Brewster, June 7. An oblique pump, Jonathan Hunt, June 7. "A tallow lamp," John Love, June 11. A composition for pills, Samuel Cooley, June 6. Improvement in stoves, John W. Godfrey and William Lane, July 14. Method of preserving vessels, &c. from worms, Raphaelle Peale, December 14. Improvement in making bread, William Banks, December 14. Machine for cutting screws, David Wilkinson, December 14. Improvement in manufacturing paper, Cyrus Austin, December 14, Pipes and pumps for conveying water, Mark Reeve, December 14. Machine for clearing docks and harbours, Stephen Colver, December 14. Machine for heaving down vessels, raising weights, &c. Stephen Colver, December 14.

1799.

Machine for raising water, Joseph Huntley, Jan. 10. Machine for writing with two pens, Mark Isambard Brunel, Jan. 17. Method of regulating wind-mills, Thomas Thompson, Jan. 3. Machine for making nails, Seth Hart, Jan. 4. Machine for manufacturing salt, John Sears, Jan. 24. Improvement in a coal stove, Henry Abbot, Jan. 24. Machine for cultivating corn, beans, &c Eliakim Spooner, Jan. 25. Machine for planting corn, beans, &c. Eliakim Spooner, Jan. 25. Improvement in a horizontal water-wheel, Ezekiel Reed, Feb. 14. Improvement in steelyards, Benjamin Dearborn, Feb. 14. Preparation of steel for cutting glass, Benjamin Du Val, Feb. 14 Improvement in making nails, Jacob Perkins, Feb 14 A flax and hemp mill, Benjamin Tyler, Feb. 26. Improvement in casting iron, William Hancock, Feb. 26. Extracting oil from cotton seeds, Charles Whiting, March 2 Improvement in sharpening axes, &c. John Shotwell, March 16. A check to detect counterfeits, Jacob Perkins, March 19. Improvement in propelling boats, Josiah Shackford, March 21. Machine for dressing cloth, Isaac Sandford, March 27. Obtaining force from water by steam, Samuel Morey, March 27. Machine for making combs, Phineas Pratt, April 12. Improvement in his water engine, Samuel Morey, April 24, Double-centered mill for wind or water, Benjamin Dearborn, April 30 New method of cutting clay for tiles, Andrew W. Duty, May 8. Machine for raising water, William Farris, May 17. "Machine to keep a ship's distance at sea," Chester Gould, May 27. Improvement in making ropes, Michael Wigglesworth, June 26. "Bilious pills, Samuel H. P. Lee, June 26. Improvement in washing clothes, Ezra Weld, June 26. Napping hats, James Long, Aug. 5. Purifying spermaceti oil, Richard Robotham, Aug. 14. A capstan fire-engine, Samuel Eli Hamlin, Aug 30. Federal balloon, Moses M'Farland, October 28. Manufacturing of paper, Robert R. Livingston, Oct. 28. Universal pump, Apollos Kinsley, Oct. 28. Boat for descending rapid streams, Daniel Keller, Nov. 5. Pumps for ships, mines, &c. John Stickney, Nov. 29. Saw-mill, Thomas Payne, Dec. 2. Extracting oil from Palma Christi, John G. Gebhard, Feb. 4. Hawks' pills, John Hawks, Dec. 14. Improvement in mills, Havilard Chase, Dec. 16. "Effeminate ropery for spinning rope yarn," John Pitman, Dec. 24.

1800.

Improvement on stoves and grates, Oliver Evans, Jan. 16. Machine for spinning rope yarn and twine, Stephen Gorham, Feb. 4. Composition to preserve wood, brick, &c. Silas Constant, Feb. 4. Machine for pounding rice, gunpowder, &c. Benjamin Bolitho, Feb. 7. Metal boxes for wood or iron to turn in, Wi'liam Shotwell, Feb. 7. Improvement in piano fortes, John J. Hawkins, Feb. 12. Method of covering salt vats from the weather, Hattil Killey, 2d, Feb. 12. Extracting the essence of sumach, fera, &c. for tanning, Nathaniel Ladd, Feb 12. Engine for throwing water, Patrick Lyon, Feb 12. Raising or lifting hides in tanning, James Cox, Feb. 20, Improvement in grist mills, Benjamin Tyler, Feb. 20. Improvement in dying blue, John Percy, March 3. Lathe or loom for weaving, William Harris, March 15. Machine for manufacturing sumach, Comfort Hoyt, jun. April 7. Improvement in coach collars. William Hottensteen, April 10. Stop cock, Peter Walker, April 10. Improvement in the manufacture of boots and shoes, Dean Howard, April 10. Improvement in the elastick truss for ruptures, Silas Stone, May 6. Engine for reducing silk, cotton, worsted, cloth, &c. to their original state, to be manufactured, John Biddis, May 6. Silent moving timekeeper, Simeon Jocelin, May 8. Improvements in the construction of ships and vessels, Jeremiah Brown, May 14. Machine for making bricks and tiles, George Hadfield, May 15. Metal amulets, Edward West, May 19. Machine for splitting hides and skins, Thomas O. Harrison, May 19. Mould board of a plough, Robert Smith, May 19. Cogs, &c. for pullies, &c. William Shotwell, June 24. Machine for cutting tobacco, Peter Lorillard, June 28. Kiln for drying grain, James Deneale, jun. July 10. Improvement in burning lime, &c. Peter Lossing, Aug. 4. Machine for cooking, Frederick Butler, Aug. 22. Machine for cutting and heading nails, Frederick Young, Aug. 23. "Lavater," machine for washing and wringing clothes, Ezra Weld, Sept. 17. Machine for cutting tanner's bark, Jonathan Kilborn, Aug. 23. Improvements in chimneys, David Cooley, jun. and Gabriel N. Philips, Aug. 25. Improvement in manufacturing bricks, Richard Mansfield, Oct. 24. Raising water for mills, Aaron Brookfield, Oct. 24. Improvement in musical instruments, John J. Hawkins, Oct. 24 Telegraph (description) filed, Jonathan Grout jun. Oct. 24. Obtaining force from water, with the assistance of steam, Samuel Murray, Nov. 17. Hanging windows without weights, William Young, Nov. 20.

1801.

Machine for breaking flax, John Cannon, Jan. 17. Jaundice bitters, Jesse Wheaten, Jan. 17. Cotton gin, Ebenezer Whiting, Jan. 22. Improvement in sheathing vessels, Henry Guest, Jan. 26. Brewing with Indian corn, Alexander Anderson, Jan. 26. Condenser for heating wash in distilling, Alexander Anderson, Jan. 28. Axle tourniquet, Joseph Strong, Jan. 29. Improvement in the construction of stoves, William Henderson, Feb. 12. Improvement in evaporation, Thomas Bedwell and Benjamin Henfrey, Feb. 12. Machine for making and heading nails, Michael Garber, Feb. 20. Hydraulick machine for raising water, Barnabas Langdon, Feb. 20. Improvement in boats to ascend rivers, &c. David Grieve, Feb. 30. Increasing the surface of evaporation for the purpose of distilling, Benjamin Henfrey, March 2. Boring machine for posts for fencing, Richard Weems, March 16. Veneering plough for cabinet work, William Stillman, March 16. Hydraulick engine, John Strong, March 24. Making and discharging chain and cleaver shot, Israel Hatch, March 24. Cut nails from iron hoops, &c. rendered tough, Nathan Kent, May 1. Stove, screw, and reel grain drying machine, David Ellicot, May 1 Impellent pump, Solomon Thayer, June 9. Nails milled out of heated rods, Jesse Reed, June 9. Extract of bark for dying, &c. Samuel Downing, June 12. Forcing pump, John Eveleth, June 13. Portable vapour bath, Charles W. Peale, July 16. Infusing oil into leather, &c. Henry Guest, July 16. A beaming machine, Jeremiah Ladd, July 17. Mill for grinding painter's colours, &c. Caleb Green, July 23. Machine for extracting grain from straw, &c. Christopher Hoxie, Aug. 20. A machine for raising water, William Palmer, Aug. 25. Improvement for cooling and conveying up meal, &c. Gurdon F. Saltonstall, Aug. 21. Metallick fluted gin rollers, for cleaning cotton, Gurdon F. Saltonstall, Sept. 2. Manufacturing spoons, Thomas Bruff, Sept. 14. Giving motion to wheels within cylinders, &c. James Sharples, Sept. 15. Mechanical powers for the use of wind mills, &c. James Sharples, Sept. 15. Manufacturing potash, Thomas Power, Sept. 19. Moveable suspended beam and scale, Samuel Willis, Sept. 21. Air-pump ventilator for ships, mines, &c. Richard Robotham, Oct. 10. Machine for ruling paper, &c. Richard Robotham, Oct. 10. A syphonick steam machine, John Poole, Oct. 13. Construction of stills, Michael Krafft, Oct 28. Machine for cutting and heading nails, William Leslie, Nov. 5. Improvement in a wind-mill, John A. Morton, Dec. 16. Improvement in a ship's pump, George Clymer, Dec. 22. Making paper from currier's shavings, Joseph Condit, jun. Dec. 28.

1802.

Improvement in the art of engraving, Joseph Hutton and Gideon Fairman, Jan. 8. Improvement in a wind-mill, Rufus Hathaway, Jan. 20. Improvement in a time-piece, Simon Willard, Feb. 8. A machine for churning, Isaac Baker, Feb. 20. Improvement in boxes for carriages, Thomas B. Whilock, Feb. 23. Improvement in paddles for propelling boats, Richard Claiborne, Feb. 23. Improved mode of carrying fish in warm weather, Nathaniel Robbins, March 11. Machine for cutting and grinding bark, Jacob Warrel, March 17. Manufacturing starch from potatoes, John Biddis, March 22. Improvement in a grist mill, John W. Holly, March 27. Improvement in a saw mill, which returns the log after each cut, Moses Coates, April 1. Improvement on a block macking gang-lathe, Ebenezer Whiting, April 1. Machine for ginning cotton, William Bell and Samuel de Montmollin, April 7. Machine for churning, Joel Pierce, April 10. Improvement, being a cheap mode of obtaining light from fuel, Benjamin Henfrey, April 16. Extracting the essence of bark for dying, Samuel Downing, April 19. Machine for cleaning clover seed, Asher Spicer, April 22. Improvement in a saw mill, Hezekiah Richardson, jun. and Levi Richardson, April 28. Machine for rolling iron round, &c. Henry Abbott, May 4. Improvement in casting close stoves, Henry Abbott, May 4. Improvement in flat roofs for houses and balconies, Henry Johnson, May 10. Mode of improving spirits, Burgiss Allison, May 12. Scientifick steelyards, Lewis du Pré, May 12. Machine for manufacturing salt, Benjamin Ellicott, May 12. New plan for printing musick. Andrew Law, May 12. Machine for cutting fur for the use of hatters, Nicholas Young, May 14. Machine for cutting nails, Edward West, July 6. Improvement in heading and cutting nails, Edward West, July 6. Improvement in a gun lock, Edward West, July 6. Improvement in a steam boat, Edward West, July 6. Improvement in pumps, Jacob Perkins, July 9. Machine for cleaning wheat, Stephen Stilwell, July 9. Machine for cleaning out docks, John Greenleaf, July 13. Method of rolling iron for nails, Jesse Reed, July 15. Improved machine for threshing and cleaning wheat, Ezekiel Miller, July 19. Machine for making bricks, Ezekiel Miller, July 17. Machine for cleaning clover seed, Martin Miller, July 19. Machine for threshing grain, Joseph Pope, July 22. Antibilious pills, Thomas H. Rowson, July 24. Machine for making nails, Nathan Forbes, Aug. 2. Improvement in a trigonometrical quadrant, James Templeton, Aug. 17. Improvement in a still, William Paine Aug. 24. Improvement called a fire-stop, Elisha Putnam, Aug. 24. Economical house and ship steam kitchen, Nicholas Boureau, Aug. 30. Astronomical quadrant, Matthew C. Groves, Sept. 3. Machine for heading nails, Benjamin S. Walcott, Sept. 4. Improvement in fastening, in raising and supporting window sashes, Leonard Kennedy, Sept. 7. An evaporating furnace, John Richardson, Sept. 13. Machine for pressing cotton or other bale goods, Jacob Idler, Sept. 24. A steam engine (improvement in) Samuel Briggs, Jun. Oct. 9. Machine for raising water [a perpetual motion !!!] John Baptiste Aveilhé, Oct. 14. Improvement in splitting skins, Asa W. Chickering, Nov. 29. Improvement in extracting neutral salts from alkaline, Benjamin Gorton, Nov. 29. Improvement in erecting dry docks, John Gardiner, Dec. 3. Machine for making nails, William Caruthers, Dec. 13. Improvement in the construction of mill wheels, James Cowen, Dec. 14. Improvement in stills, John Staples, Dec. 15. Improvement in making salt, Valentine Peers, Dec. 18. Improvement in a boiling cistern, Timothy Kirk, Dec. 28. Antibilious stomach cordial, Simon Lozarus, Dec. 21. Improvement in the manner of welding cast steel to iron, &c. Daniel Pettibone, Ezekiel Chapman, and Josiah Nichols, Dec. 22. An insubmersible boat, Abm. Du Buc Marentille, Dec. 23. Improvement in manufacturing paper from corn husks, Burgiss Allison and John Hawkins, Dec. 30. Machine for sawing stone and marble, William Palmer, Dec. 31.

1803.

Improvement in the caboose of a vessel for distilling fresh from salt water, Simeon Rouse, Jan. 1. A saw mill for cleaning cotton, Gurdon F. Saltonstall, Jan. 4. Machine for hulling rice, Christopher Hoxie, Jan. 7. Refrigerator for domestick uses, Thomas Moore, Jan. 27. Boiler for accelerating the evaporation of liquids, John Moffat, Feb. 1. Im provement in stills, John Moffat, Feb. 1. Machine for raising water, Benjamin Cooley, Feb. 1. Manufacturing marle into lime, Jedediah Peasley, Feb. 1. Making brandy out of all kinds of grain or fruit, Christopher J. Hütter, Feb. 11. Machine for paring apples, Moses Coats, Feb. 14. Improvement in a gauge auger, Abel Stowel, Feb. 14. A machine for making hot wrought nails, &c. Elisha Bartlett, Oliver Bartlett, Otis Bartlett, and George Bartlett, Feb. 17. Improvement to their patented roller cotton gin, William Bell, and John S. D. Montmollin, March 7. Improvement in extracting a spirit from starch water, John Naylor, March 7. A wheel to turn under water, Silas Bent, March 7. A horizontal wind mill, John Baptiste Aveilhé, March 16. A wreck raft, Abraham Du Buc Marentille, March 18. A sea sitting chair, Abraham Du Buc Marentille, March 18. A power obtained by the rising and falling of the tide to give motion to all kinds of machinery, John Staples, jun. March 18. Submarine passage, or hollow inverted arch, John Staples, jun. March 18. A machine for cleaning clover seed, John Cottle, March 21. An improvement in time pieces, David F. Launay, March 21. Improvement in the process of manufacturing sea salt, George Hunter, March 24. Improvement in the mode of obtaining antiseptick gas, Peter De La Be arre, and J. B. M. Picornell, March 24. Improved house fan, Edward Marquam, March 28. Antibilious pills, Thomas H. Rawson, April 4. Improvement in his evaporating furnace, John Richardson, April 4. Improvement in a cooler or condenser of vapour, William How, April 6. Improvement in producing steam, John Stevens, April 11. Improvement in a ruling machine, Daniel Brewer, April 22. Improvement in heating and boiling water, Benjamin Platt, April 27. Improvement in the mode of constructing vessels with crooked keels, Eliphalet Beebe, April 27. Machine for deepening channels, Matthew Barney, May 4. Improvement in building boats, William Hopkins, May 13. A rolling machine for cleaning cotton, Gurdon F. Saltonstall, May 14. Improvement in distilling spirits, Daniel Ilsley, May 14. Improvement in cutting grain and grass, Richard French, and John T. Hawkins, May 17. Improvement in the pentagraph and parallel ruler, John J. Hawkins, May 17. Improvement in the application of the principle of rectifying or improving spirits, Burgiss Allison, May 17. Machine for pumping, John Clarke, May 19. Improvement in working the bellows of a furnace or a forge, John W. Godfrey, May 25. Expediting the manufacture of common salt, Timothy Alden, jun. May 24. Improvement in the method of distilling or making alcohol, Lemuel J. Kilborn, June 4. Improvement in extracting the effective matter contained in barks, &c. for dying, John Biddis, Thomas Bedwell, and William Mitchell, June 7. Machine for making hinges, David Morse, June 10. Improvement in the manufacturing of hats, Ezra Corning, jun. June 13. Improvement in the steam engine, Samuel Morey, Rufus Graves, and Giles Richards, June 15. Physiognotrace, Isaac Tood, Augustus Day, and William Bache, June 15. A rocking churn, Walter Keeler, and James Waring, June 23. A machine for breaking and carding sheep's wool, Benjamin Standring, June 28. Machine for shearing woollen and other cloths, Liberty Stanley, June 25. Machine for pulling hair from skins, Nicholas Young, June 28. Improvement in the construction of iron cabooses, William Ashbridge, June 28. Improvement called the Columbia fire-place, Robert Heterick, June 30. Improvement in the mode of applying springs to window sashes, Samuel S. Camp, July 1. Improvement in distillation, by the application of steam in wooden or other stills, Samuel Brown, Edward West, and Thomas West, July 8. Machine for packing goods, John Clark and Evan Evans, July 20. Method of cooling liquors, David Lownes, July 21. Method of securing leaden or other pipes from frost, &c. David Lownes, July 21. Machine for splitting and shaving shingles, Daniel French, July 25. Improving in a powder mill, George Keyser, July 27. Machine for separating clover seed from the "pod," Timothy Kirby, July 28. Improvement in the construction of sills, Lewis Geanty, Aug. 4. Machine for boring holes in rocks undes water, John Baptist Aveilhé, Aug. 24. Improvement in a water cock, George Youle, Aug. 25. Preparing seals' fur for hats, George Cleveland, Sept. 9. A wheel press, Hezekiah Betts, Sept. 13. Mode of constructing carriages, John C. Stroebel, Sept. 19. Family pills, Daniel Coit, Oct. 15 Machine for making wrought nails and brads out of hot rods, Lazarus Ruggles, Oct 18. Threshing machine, Jedediah T. Turner, Oct 19. Improvement in the construction of the keels of vessels, Gilbert Livingston, Oct. 22. Machine for shelling corn, Paul Pilsbury, Oct. 25. Improvement in boilers, also working stills with the same, William Thornton, Oct. 28. A horizontal draft wind-mill, Samuel Goodwin, Oct. 31. Finding salt water and metals. *Bletonism!* Valentine Cook, Nov. 1. Vegetable elixer, or cough drops, Samuel Cooley, Nov. 12. A dry bellows pump, Enoch Alden, Nov. 15. Improvement in spinning wheels, Amos Minor, Nov. 16. Improvement in wind-mills, Asahel E. Paine, Nov. 19. Improvement in fastening and supporting window sashes, Jacob Osborn, Nov. 24. Improvement in the cotton gin, William Bell, Nov. 24. Improvement in propelling boats for inland navigation, William Bell, Nov. 25. Improvement in the wind-mill, William Bell, Nov. 25. A cylindrick ruler for ruling paper, John Fairbanks, Nov. 30. Improvement in grinding painters' colours, printers' ink, &c. Jacob Cist, Dec. 2. Machine for separating the seed from cotton, Joseph Eve, Dec.

6. A twilling machine for pricking leather for cards, Pliny Earl, Dec. 6. Improvement in a fire engine, Stephen Seward, Dec. 6. Machine for rolling plates of iron and cutting them into nails, Samuel Rogers and Melville Otis, Dec. 7. Improvement in window springs, James Curtis, jun. Dec. 10. Improvement in still heads and condensers, Edward Richardson, Dec. 16. Improvement in making cold cut nails and brads out of rolled iron, Joseph Elgar, Dec. 16. Improvement in separating clover seed, wheat, &c. from the husk, David Buckman, Dec. 21. A hydro-mechanical press, John Beverly, Dec. 26. Improvement in painting rooms, John Selby, Dec. 20. Improvement in making colours for painting, printing, &c. Francis Guy, Dec. 30.

1804.

Machine for making brick and tile, by cutting the mortar, Nathaniel Miller and Philip W. Miller, Jan. 5. Improvement in stills or boilers, Leonard Beatty, Jan. 19. Improvement in preparing quercitron or black oak bark for exportation or home consumption, for dying or other uses, Thomas Benger, Jan. 25. "A double draught fire-place," Talmage Ross, Jan. 23. Improvement in the construction of stills, and the process of distilling spirits, William Wigton, Jan. 30. Improvement called the screw-mill for breaking and grinding different hard substances, Oliver Evans, Feb. 14. Improvement in steam engines, by the application of a new principle by means of strong boilers to retain and confine the steam, thereby increasing the heat in the water, which increases the elastick power of the steam to a great degree, Oliver Evans, Feb. 14. Improvement in wheels to be moved either by wind or water; for the purpose of giving motion to all kinds of machinery, mills, engines, carriages, ships, boats, &c. &c. John Staples, jun. Feb. 17. "In setting stills and other large kettles," Israel Wood, Feb. 21. Machine for threshing and cleaning grain, Thomas Barnett, Feb. 21. Improvement being a smut fanning-mill, Thomas Pierce, Feb. 21. Improvement in hanging window sashes, William W. Hopkins, Feb. 24. "Improvement, being a spinning wheel and twisting-mill for the purpose of making cordage," William B. Dyer, Feb. 27. A machine for hulling clover seed, Jacob Worrell, Feb. 27. Improvement in air or bellows pumps for raising water, Daniel M. Miller, March 5. Improvement, being a machine for washing clothes, scouring, fulling, and cleansing cloth, Daniel S. Dean, Feb. 20. Improvement, being a mode of preparing marble for painting on, Archibald Robertson, March 5. Improvement in window fastenings, or springs for fastening and supporting sash-lights, Daniel M. Miller, March 8. Improvement in extinguishing fires in houses, &c. Samuel P. Lord, Jun. March 10. Machine for watering cattle, Moses Smith, March 16. Improvement in the bedstead, so constructed that it may be taken down and removed by one person, in case of fire, or on other occasions, with much ease and expedition, Ward Gilman and William Jackson, March 19. Machine for preparing what is commonly called top and swingled tow for paper, Abraham Frost, March 19. Improvement, being a "wry-fly," which may be applied by wind or water to various machines, viz. grist-mills, hulling-mills, spinning-mills, fulling-mills, paper-mills, and to the use of furnaces, &c. Benjamin Tyler, March 19. Improvement in manufacturing coat and waistcoat buttons, George W. Robinson, March 24. Improvement, being an inclined-plane-statical-wheel machine, for facilitating the passage of boats in canals, or for removing earth, stones, or heavy bodies from hills, &c. by the inclined plane, John Williams, March 23. Machine for the improvement of navigation, Anthony Hunn, March 24. "Improved still and boiler," John Naylor, March 31. Improvement in the mode of making shot, Phineas Daniel, March 31. Machine for breaking and cleansing flax and hemp, Owen Roberts, April 12. Improvement in the mode of working sheet tin into different wares, Calvin Whiting, and Eli Parsons, April 14. Improvement in springs for window sashes, Joseph Eaton, April 14. Machine for slitting and heading nails, Michael Garber, April 17. Double steam-bath still, John James Giraud, April 18. Machine for cleaning flax-seed from cockle, yellow-seed, cheat, and all foul seed, which may be applied to separate wheat, rye, and other grains from each other, and all impurities, Paul Goltry, April 24. Machine for shelling clover seed, Michael Withers, April 30. Improved machine for cutting straw and hay, &c. &c. Moses Coates and Evan Evans, April 30. Improvement in paper-mills, Thomas Langstroth, May 1. Improvement in the construction of pump-boxes, or pumps, designed for the use of ships of war, merchant vessels, or other purposes where water is required to be raised, John Stickney, May 1. Columbian threshing, break and cleaning fan, Samuel Houston, May 3. Machine to be fixed to the top of a common churn, Levi Stephens, May 8. Machine for shelling and cleaning corn, which may likewise answer the purpose of grinding tanners' bark, and provender for cattle and horses, Levi Stephens, May 8. Improvement of the lantern, John Staniford, jun. and Amos D. Allen, May 10. Composition for tablets to write or draw on, Amos D. Allen, May 10. Machine to cut strips or chips of wood to make chip hats, bonnets. &c. Amos D. Allen, May 10. Furnace for making pot and pearl ashes, with the manner of using, and the materials of which the same is composed, Edward Crafts, jun. May 12. Machine or apparatus for making salt, Ezra Weld, May 16. Machine for cleaning and moating cotton after it has been ginned, James Simons and Joseph M'James, May 17. Machine for making nails and spikes, Burgiss Allison and Richard French, June 8. Improvement in making thimbles, Asa Spencer, June 8. Improvement in machines for clearing grain from straw, &c. William Tunstall, June 30. Improvement in the mode of pumping and raising water, Benjamin Folger, July 7. Improvement in the construction of the fulling mill, called the double crank, Levi Osborn, July 12. Improvement in the plough, John Deaver, July 12. Improvement in the auger, Christopher Hoxie, July 12. Improvement in the lime-kiln, Thomas Power, July 12. Metallick grinder, or hone for razors, penknives, scissors, surgeons' instruments, and all kinds of fine-edged tools, Christian Veltenair, Aug. 10. Improvement in the machine for cutting nails, Nicholas Boureau, Aug. 21. Machine for raising water from wells, William Harrington, Aug. 28. Improved windlass for ships or vessels, Hezekiah Betts, Aug. 29. Machine to cut chips or strips of wood to make chip hats and bonnets, brooms, baskets, sieves, matting, and for various other uses, John Roberts, Amos D. Allen, and Ezekiel Kelsey, Sept. 5. Crushing plaster-mill, Emanuel Kent, Sept. 14. Improvement in suspenders, Orange Webb, Sept. 18. Improvement in windmills, Richard Weems, Sept. 20. A wagon, or carriage, to be worked by hand, John Bolton, jun. Sept. 29. Method to prevent chimneys from admitting water in rainy weather, John James Thomas, Oct. 2. Forcing pump to raise water, Aaron Taylor, Oct. 4. "The rheumatick liniment," for chronick rheumatism, strains, &c. Abel Brown, Oct. 17. Improvement in gallows, or suspenders, for breeches, pantaloons, or trowsers, &c. Simon Smith, Oct. 23. Improvement in candlesticks, Benjamin Dearborn, Oct. 29. Machine for breaking dough, Laban Folger, Nov. 1. Machine for cooling and filtering water or other fluids, Daniel M'Mullin and Thomas M. Corby, Nov. 6. Composition, or cement, to prevent the roofs and other parts of houses from taking fire, David Stodder, Nov. 16. Improvement in sash springs, John Hooker, Nov. 19. Improvement in the threshing machine, James Deneale, jun. Nov. 20. Improvement in the oil press, Josiah White, Nov. 27. Machine for granulating gunpowder, E. I. Du Pont de Nemours, Nov. 23. Improvement in the cow or sheep bell, Simon Newton, Dec. 22. Machine for cutting nails with, and not across, the grain of the metal, Frederick William Geyssenhayer, Dec. 22. Improvement in wind-mills, William Stanton, jun. Dec. 26. "New invented window springs," Isaac Scott, Dec. 26 Machine for boring gun-barrels, Nathan Fobes, Dec. 31. Manufacturing ashes, Joseph Bellows, jun. and Ebenezer White, Dec. 29. Medicine called "bilious cordial," Samuel Chamberlaine, Dec. 31. Mode of improving or setting a horse's ears, Seth Janes, Dec. 31.

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